

## *Lecture 11*

# Market Overview of Mobile Operating Systems and Security Aspects

**Mobile Business I (WS 2011/12)**

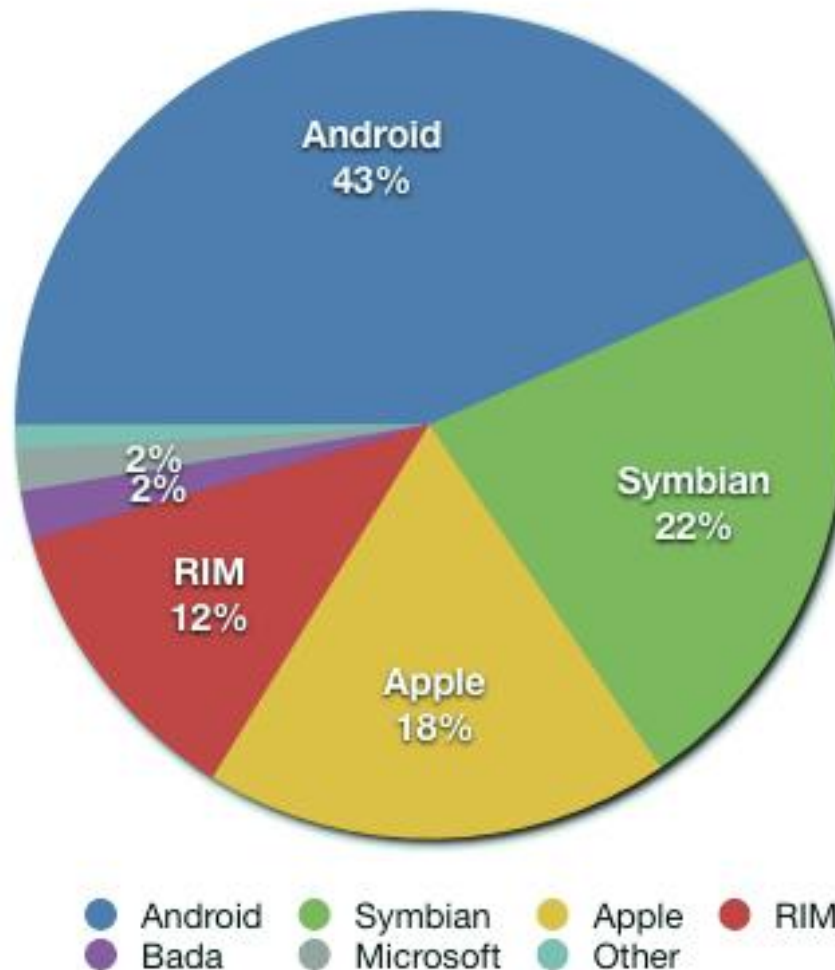
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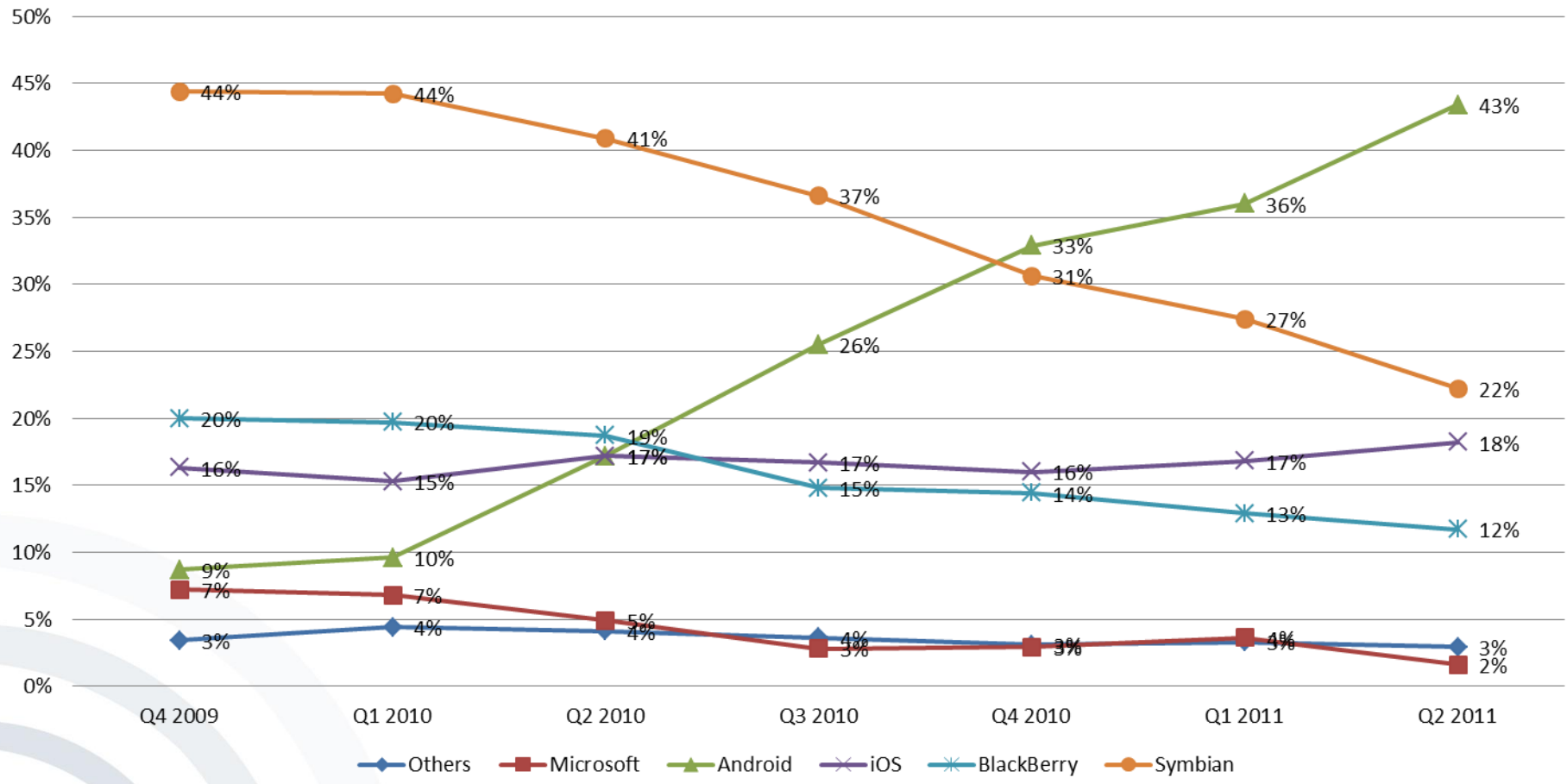
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- Manufacturer-independent mobile OS
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# Worldwide Smartphone Sales to End Users by Operating System (Q2 2011)



[Gartner2011]

# Worldwide Smartphone Sales to End Users by Operating System (2009-2011)



# Worldwide Smartphone Sales to End Users by Operating System (Q2 2011)

**Worldwide Smartphone Sales to End Users by Operating System in 2Q11  
(Thousands of Units)**

Operating System	2Q11 Units	2Q11 Market Share (%)	2Q10 Units	2Q10 Market Share (%)
Android	46,775.9	43.4	10,652.7	17.2
Symbian	23,853.2	22.1	25,386.8	40.9
iOS	19,628.8	18.2	8,743.0	14.1
Research In Motion	12,652.3	11.7	11,628.8	18.7
Bada	2,055.8	1.9	577.0	0.9
Microsoft	1,723.8	1.6	3,058.8	4.9
Others	1,050.6	1.0	2,010.9	3.2
<b>Total</b>	<b>107,740.4</b>	<b>100.0</b>	<b>62,058.1</b>	<b>100.0</b>

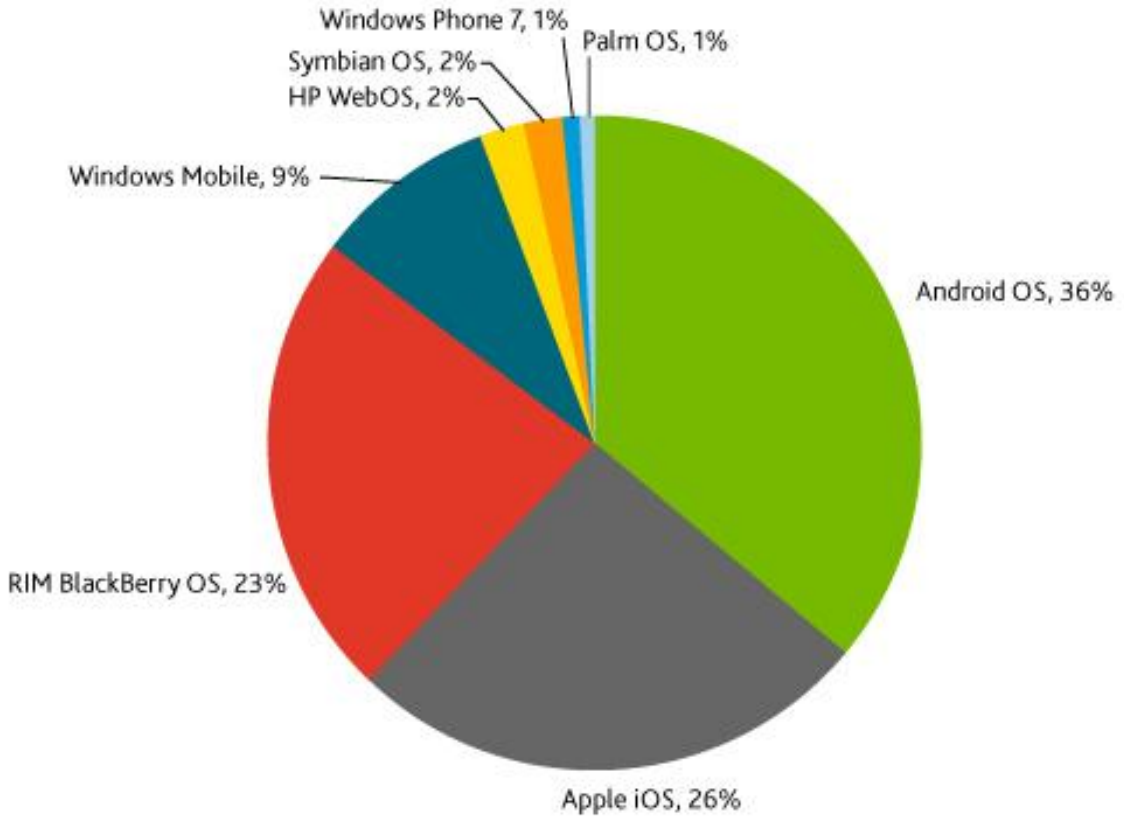
Source: Gartner (August 2011)

[Gartner2011]

# US smart phone market by OS vendor (Q1 2011)

## Smartphone Share

Feb - Apr 2011, Nielsen Mobile Insights, National



Source: Nielsen



# Worldwide Smart Phone Market Shares (Q4-2010 vs. Q4-2009)

**Worldwide smart phone market  
Market shares Q4 2010, Q4 2009**

OS vendor	Q4 2010		Q4 2009		Growth Q4'10/Q4'09
	shipments (millions)	% share	shipments (millions)	% share	
<b>Total</b>	<b>101.2</b>	<b>100.0%</b>	<b>53.7</b>	<b>100.0%</b>	<b>88.6%</b>
Google*	33.3	32.9%	4.7	8.7%	615.1%
Nokia	31.0	30.6%	23.9	44.4%	30.0%
Apple	16.2	16.0%	8.7	16.3%	85.9%
RIM	14.6	14.4%	10.7	20.0%	36.0%
Microsoft	3.1	3.1%	3.9	7.2%	-20.3%
Others	3.0	2.9%	1.8	3.4%	64.8%

\*Note: The Google numbers in this table relate to Android, as well as the OMS and Tapas platform variants

Source: Canalys estimates, © Canalys 2011

# Worldwide Smart Phone Market Shares (Q4-2006 vs. Q4-2005)

Worldwide total smart mobile device market Market shares Q4 2006, Q4 2005					
Vendor	Q4 2006 shipments	% share	Q4 2005 shipments	% share	Growth Q4'06/Q4'05
<b>Total</b>	<b>22,124,400</b>	<b>100.0%</b>	<b>17,053,930</b>	<b>100.0%</b>	<b>29.7%</b>
<b>Nokia</b>	11,114,630	50.2%	9,268,410	54.3%	19.9%
<b>RIM</b>	1,829,260	8.3%	1,185,340	7.0%	54.3%
<b>Motorola</b>	1,463,090	6.6%	777,580	4.6%	88.2%
<b>Palm</b>	1,211,930	5.5%	1,563,680	9.2%	-22.5%
<b>Sony Ericsson</b>	1,137,360	5.1%	108,710	0.6%	946.2%
<b>Others</b>	5,368,130	24.3%	4,150,210	24.3%	29.3%

Source: Canals estimates, © canals.com ltd. 2006-2007  
Smart mobile device market: handhelds, wireless handhelds, smart phones

## Long time trends (maybe?)

- Big players (originally from neighbouring fields) have always some (relatively modest) market share due to high investment:
  - Nokia: Mobile phones
  - Microsoft: Architectures, operating systems
- Killer Application Champions are very successful for some time until their killer application is also available from the big players:
  - Palm: 1st small and affordable PDA with address book, calendar, and PC connectivity
  - RIM Blackberry: 1st PDA phone with push email

- Due to the limitations of the mobile devices, mobile operating systems also have to cope with the following challenges:
  - Limited device capabilities and resources (storage, memory, processing time, etc.)
  - Usability issues
  - Security and system integrity issues

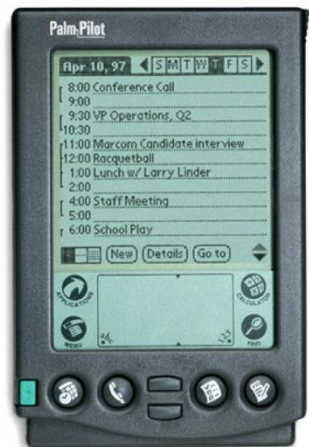
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## Mobile OS unavailable to other device manufacturers

- In the past, most mobile phone manufacturers used their own “closed” operating systems for their mobile devices.
- Today, more and more platforms switch to more open and interoperable operating systems (e.g. Windows CE, Symbian OS).
- Some manufacturers (still) rely on own OS, e.g. RIM Blackberry OS, Apple iOS.
- **Advantage:** Tend to be not as much affected by malware than “open” operating systems
- **Disadvantage:** Less flexible, as 3<sup>rd</sup>-party software cannot be easily installed and executed

- Palm OS (Garnet OS)
  - Latest release: Most devices equipped with Palm OS 5.4
- Apple iOS (Unix-based)
  - Latest release: iOS 4.3
- RIM BlackBerry OS
  - Latest release: BlackBerry OS 6.0
- Samsung bada
  - Latest release: 1.2 (Samsung S8530 Wave II phone)

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All screens are simulated.

- The operating system is made by *palmsource*
- Several device manufacturers:
  - Palm (e.g. Treo series)
  - Handspring
  - Garmin (navigation devices)
  - Fossil
  - Samsung
  - Sony
  - ...
- Current version 6.1 (Cobalt)
  - There are no devices using version 6.1 on the market. Most of the devices are equipped with Palm OS 5.4 (Garnet), such as the Tungsten series.



- Communication:
  - IrDA
  - Bluetooth
  - WiFi (IEEE 802.11)
  - GSM/GPRS
  - CDMA
- Support of the TCP/IP network protocol
- Integrated personal information management (PIM)
- Support for several encryption and security algorithms (e.g. RSA, SHA1, RC4)
- Large choice of 3rd party software available
- Long battery life

- 1996: Palm Pilot 1000
  - First device using Palm OS
- 1998: Palm III
  - Using Palm OS v3
- 2000: Palm IIIc
  - First device using Palm OS and a colour display
- 2003: Palm OS 5
- 2004: Palm OS 6.1 (Cobalt) and Palm OS 5.4 (Garnet)
- 2006: Palm's "*Treo Smartphones*" with Windows Mobile
- Name change to Garnet OS - future versions will be based on the Access Linux Platform.
- 2010: Hewlett-Packard acquired Palm for \$1,2 billion (HPwebOS)
- 2011: HP announced to stop the production of all HPwebOS devices, including smart phones and tablets



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## Apple iOS



- Developed by Apple for iPhone, iPod Touch, iPad and Apple TV
- Latest release: iOS 4.3
- iOS derived from Mac OS X, a Unix-based operating system
- Apple does not permit the OS to run on third-party hardware
- User-interface uses multi-touch gestures



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- Symbian platform

- Latest release: Symbian^3

- Android (by Open Handset Alliance) 

- Latest release: 2.3 (Gingerbread)

- Windows Mobile


- Latest release: Windows Mobile 6.5.5

- Windows Phone

- Latest release: Windows Phone 7

- MeeGo (by Nokia, Intel) 

- Latest release: 1.1.1

- Maemo (by Nokia) 

- Latest release: 5.0

- Linux: LiMo, Openmoko Linux, Qt Extended (Qtopia) 

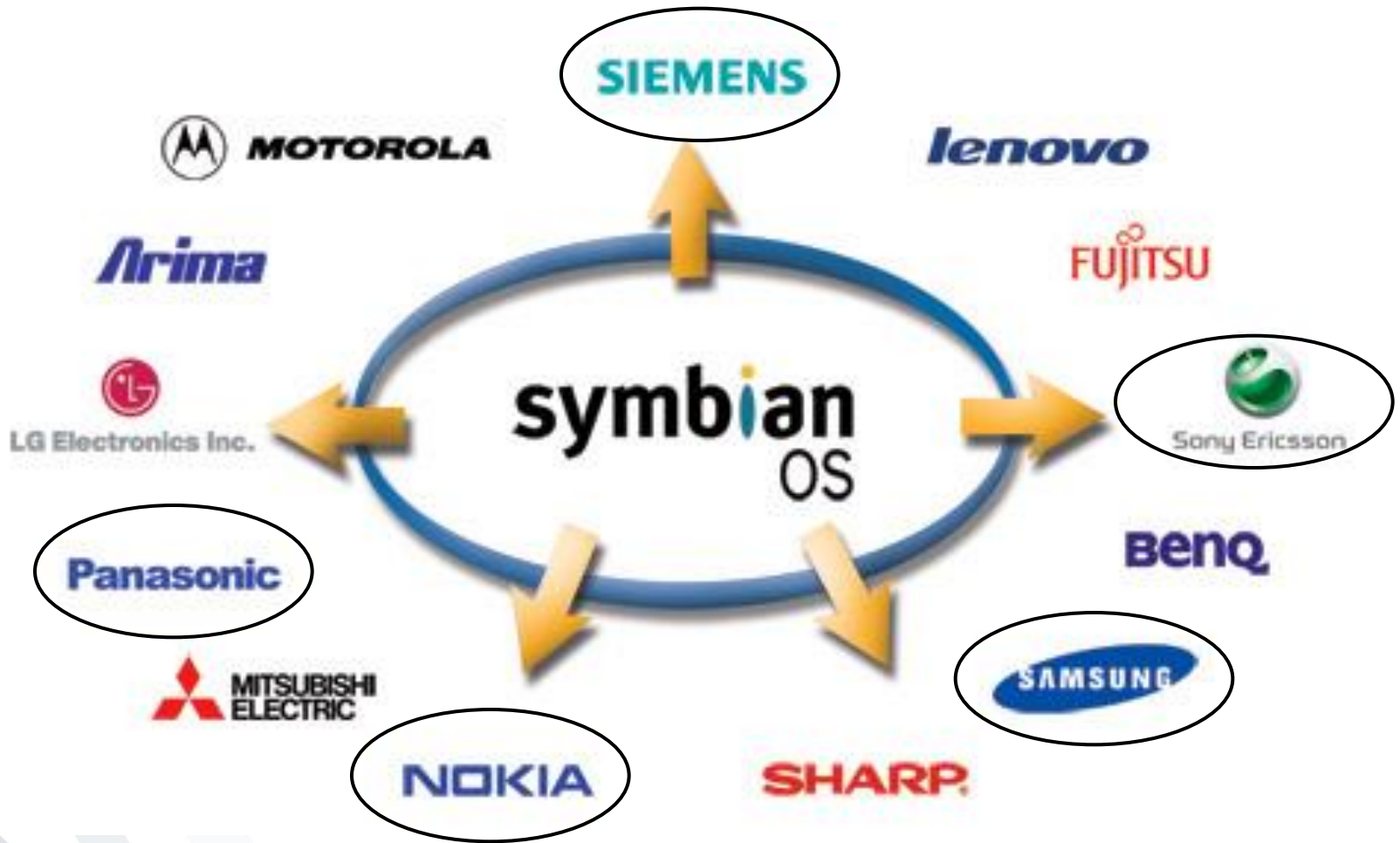
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# symbian

Symbian OS - the mobile operating system





In 2006, Symbian was owned by 

- Symbian was founded as a privately owned company in June 1998.
- Owner: Ericsson, Nokia, Panasonic, Psion, Samsung Electronics, Siemens and Sony Ericsson
- „Open“ Symbian OS telephones were available since 2001
  - „Open“: It is possible to install 3<sup>rd</sup>-party applications.
  - Beginning of 2001: Nokia 9210 Communicator
- 2004: Symbian OS 8.0
- 2005: Symbian OS 9.1 (S60 3rd edition)
- 2006: Symbian OS 9.3 released, extending the OS with WiFi and HSDPA
- 2007: Symbian OS 9.4 (S60 5th edition),
- 2008: **Symbian Foundation** announced in June 2008 and came into existence in 2009
  - The **Symbian platform** is the successor to Symbian OS and Nokia Series 60.
- 2010: Symbian OS 9.5 (Symbian^3)
- 2011: Symbian Anna and Symbian Belle as an update to Symbian^3

- First release: Symbian^1 („Symbian One“)
- December 2008: **Nokia** buys Symbian Ltd. and becomes the **major contributor** to code of Symbian platform
- November 2010: Due to a lack of support from funding members, **Symbian Foundation transition into a licensing-only organisation**
- Latest version, Symbian Belle (an update to Symbian^3), officially released in Q2 2011
- Nokia N8 first smartphone to run Symbian^3
- February 2011: Nokia collaborates with Microsoft and adopts Windows Phone 7 for their smartphones
  - Relevance of Symbian platform, especially in the mobile app market, drops significantly
  - Market share in sharp decline, notably in the high priced smartphone segment



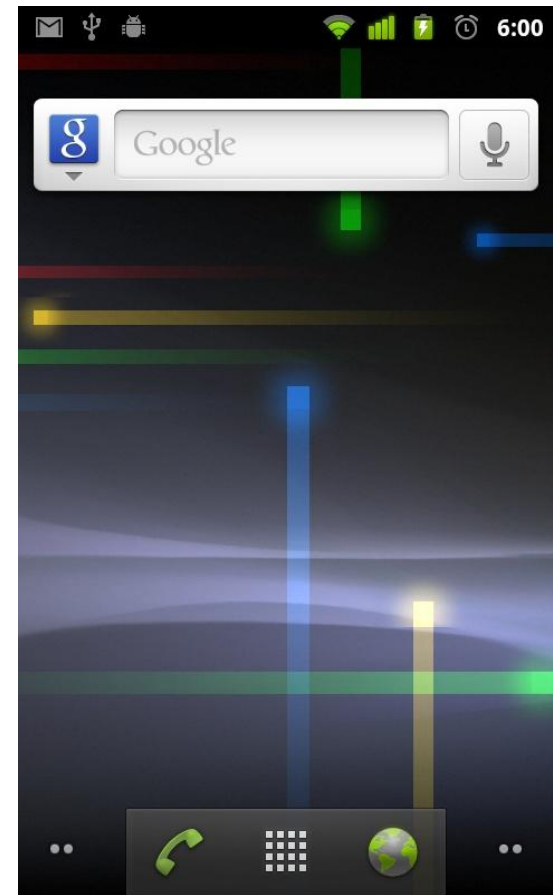
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- Linux is an „*Open Source*“ operating system.
- Only a limited amount of device manufacturers were offering devices with a pre-installed Linux solution (e.g. Motorola, NEC, Panasonic).
- However, there are several Linux distributions, such as  $\mu$ CLinux, that can be installed on existing devices (e.g. iPAQ).
- Motorola, as one of the major mobile phone manufacturers, was using Linux as (one) of their OS platforms.

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- Google and other members of the **Open Handset Alliance** collaborated to develop and release Android
- Open Handset Alliance (OHA) established in 2007
- Android based on modified version of Linux kernel
- October 2008: First commercially available phone running Android: T-Mobile G1
- September 2011: Version 3.2 Honeycomb



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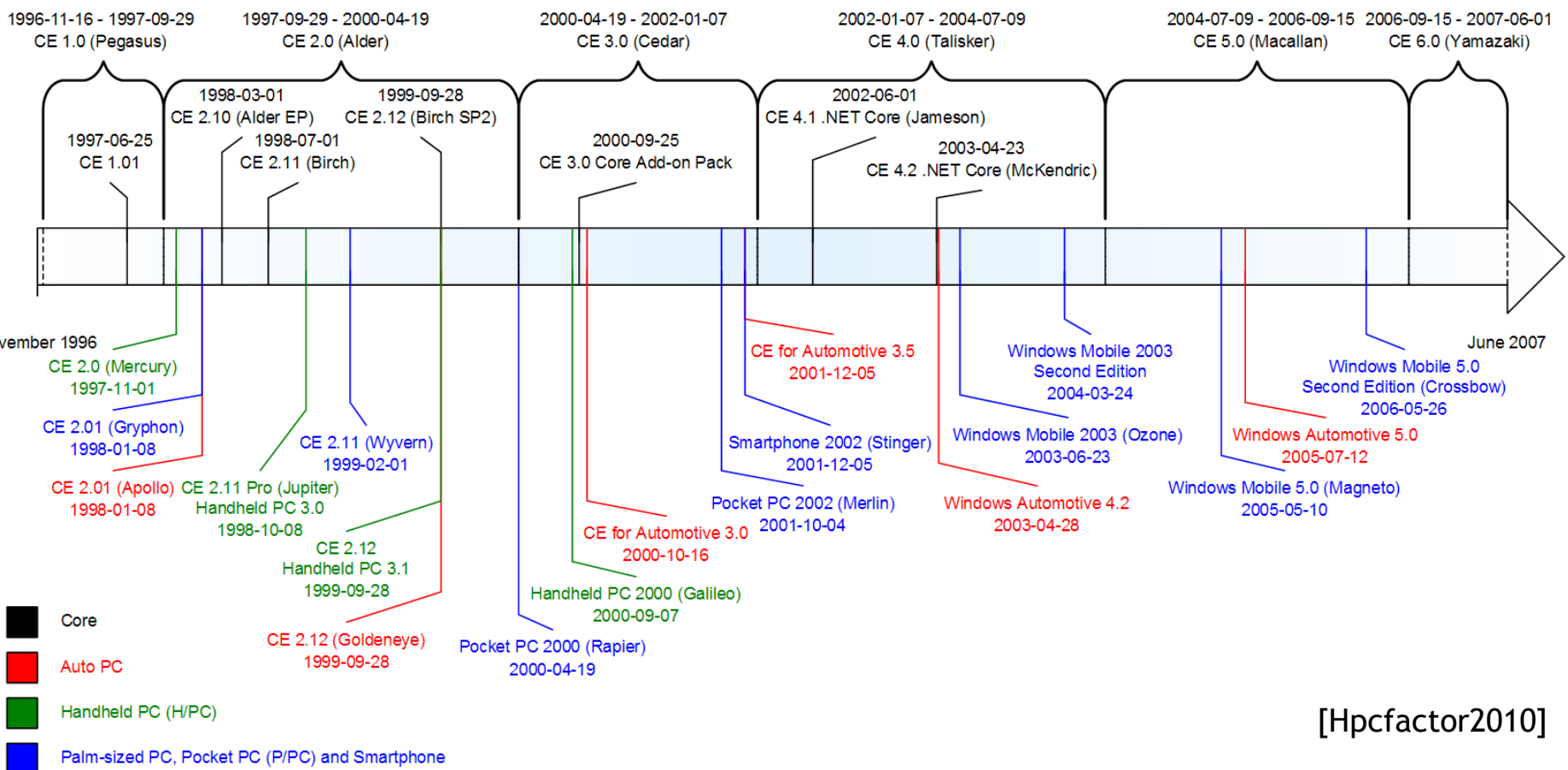


All screens are simulated.



## Windows CE Timeline

Source: "A Brief History of Windows CE" (<http://www.hpcfator.com/support/windowsce/>), HPC:Factor, retrieved May 21, 2007

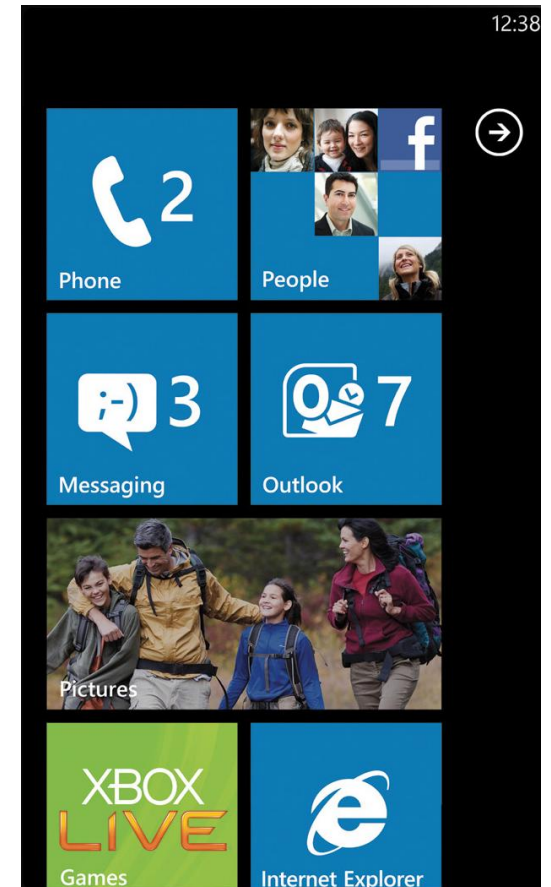


[Hpcfator2010]

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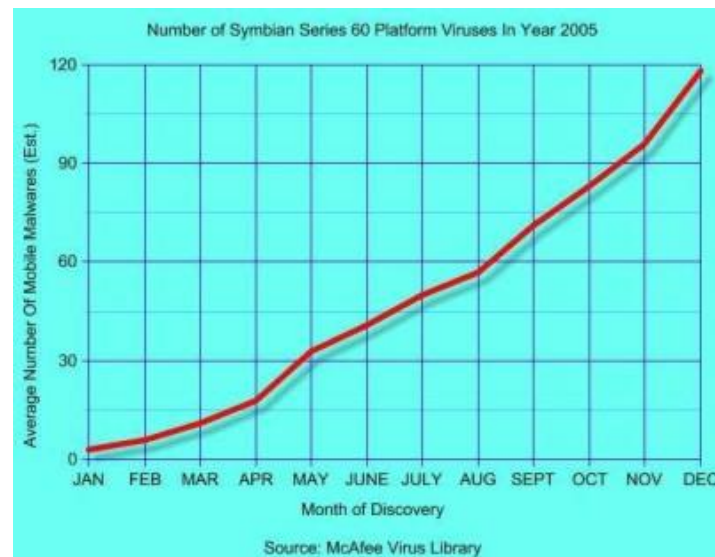
- Launched in October and November 2010
- Successor to Windows Mobile platform, but **technically a new and different platform without backward compatibility**
- Aimed at consumer market instead of enterprise market unlike Windows Mobile
- New user interface
- Major update Windows Phone 7.5 Mango in Q4 2011



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- Today, mobile operating systems allow the execution of 3<sup>rd</sup>-party software
  - As a result, malware can also be executed on mobile operating systems, either intentionally or by security leaks inside the mobile operating system (exploits).
- Possible threats for the user are:
  - Device malfunction
  - Loss of data (malware erasing data)
  - Loss of money (e.g. malware sending SMS to premium services )
  - Shorter battery runtime (more processing/resource usage)

- **09/2000:** Liberty Horse Trojan
- **12/2000:** Telefonica SMS Mailer
- **08/2001:** Flooder sends unwanted SMS
- **09/2001:** Phage erases data on Palm devices
- **02/2003:** Nokia V-Card exploit
- **09/2004:** First Symbian OS malware
- ...



- Memory protection
  - Processes are not able to access the memory of other processes.
- File protection
  - Encryption
  - Access control
- Access controls
  - Definition of access rights and monitoring of their enforcement.
- Support for security modules
- Secure I/O
- Code integrity management: Integrity of programs is checked before they are started by e.g.
  - Checking certificates
  - Proof Carrying Code
- Additional Security Software may be needed, e.g.
  - Virus scanners
  - Firewalls

- Every user has certain assigned access rights, e.g.
  - Reading a file
  - Writing a file
  - Accessing a peripheral device
- The OS controls that users or the processes started by a user, can only execute those actions, which they are allowed to.

<i>Object</i> <i>User</i>	<i>F1</i>	<i>F2</i>	<i>F3</i>	<i>Device's Periphery</i>
<b>U1</b>	Read		Read	
<b>U2</b>				Print
<b>U3</b>		Read	Execute	
<b>U4</b>	Read Write		Read Write	

# Security of Operating Systems

Operating System	Memory Protection	File Protection	Access Control	Support for Security Modules	Secure I/O	Code Integrity Mgt.
Android	✓	✓	✓	(✓)	✗	✗
Symbian 9.x	✓	✓	✓	(✓)	✗	✓
Apple iOS	✓	(✓)	(✓)	(✓)	✗	✓
Blackberry OS	✓	✓	✓	(✓)	✓	(✓)
Windows Phone 7	✓	✓	✓	(✓)	✗	✓
PalmOS 5.x	✗	✗	✗	(✓)	✗	✗
Embedded Linux	✓	(✓)	✓	(✓)	✗	✗
J2ME	✓	✗	✗	(✓)	✗	✓
PocketPC 2003 Phone Edition	✗	✗	✓	(✓)	✗	✗
Windows CE 6.2 Windows Mobile 6.5	✓	✓	✓	(✓)	✗	✓

(✓) → Feature is available, depending on the available hardware (e.g. availability of a card reader).

- [Canalys07] <http://www.canalys.com/pr/2007/r2007024.htm>, accessed 2011-09-23
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