APPLICATION PROGRAMMING: MOBILE COMPUTING
[INEA00112W]

Marek Piasecki PhD

Introduction, Mobile Platforms & Architectures (W1/2013)

Choose yourself and new technologies

Course Description

- **Code:**
  INEA00112

- **Title:**
  Application programming: Mobile Computing

- **Duration:**
  Summer term (4th semester)
  The course carries 5 ECTS credits.

- **Contact hours per week:**
  - 30 hours lecture   (2 hrs/week)
  - 30 hours workshop/laboratory (2 hrs/week)

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Course Description

Assessment and examination:

Lecture:

➢ written test during last week of the term (1/3)
  (students with a very good assessment of the lab >= 4.5,
   will be exempted from the test)

Laboratory:

➢ 10 programming exercises of medium complexity,
  each finalized with complete program (1/3)

➢ final programming task – 3 weeks ,
  every student creates a more sophisticated mobile application
  and technical documentation (1/3)

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Lecture Syllabus

- ➢ **Introduction** to Mobile Computing
- ➢ Mobile **Platforms** and Architectures
- ➢ Mobile Java – **J2ME**
- ➢ Google **Android** OS
- ➢ Microsoft **Windows Phone**
- ➢ Apple **iOS,**
- ➢ Nokia **Symbian** S60 OS
- ➢ Wireless **Telecommunication**
- ➢ Wireless **Networks**
- ➢ Mobile **Security**
- ➢ Mobile **Databases**
- ➢ Mobile **Multimedia** Services
- ➢ Emerging Mobile Technologies

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Mobile computing

What could it be ?

1. moving **software**

    – moving data $\rightarrow$ html page

    – moving code $\rightarrow$ applets

    – moving program $\rightarrow$ aglets, agents, computer viruses

2. moving **hardware** $\rightarrow$ mobile robots
    $\rightarrow$ unmanned cars/vehicles
    $\rightarrow$ portable computer devices

3. **people using computer devices while being on the move**

A little of history

Evolution of small / pocket computers . . .

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A little of history (2)

Evolution of mobile phones . . .

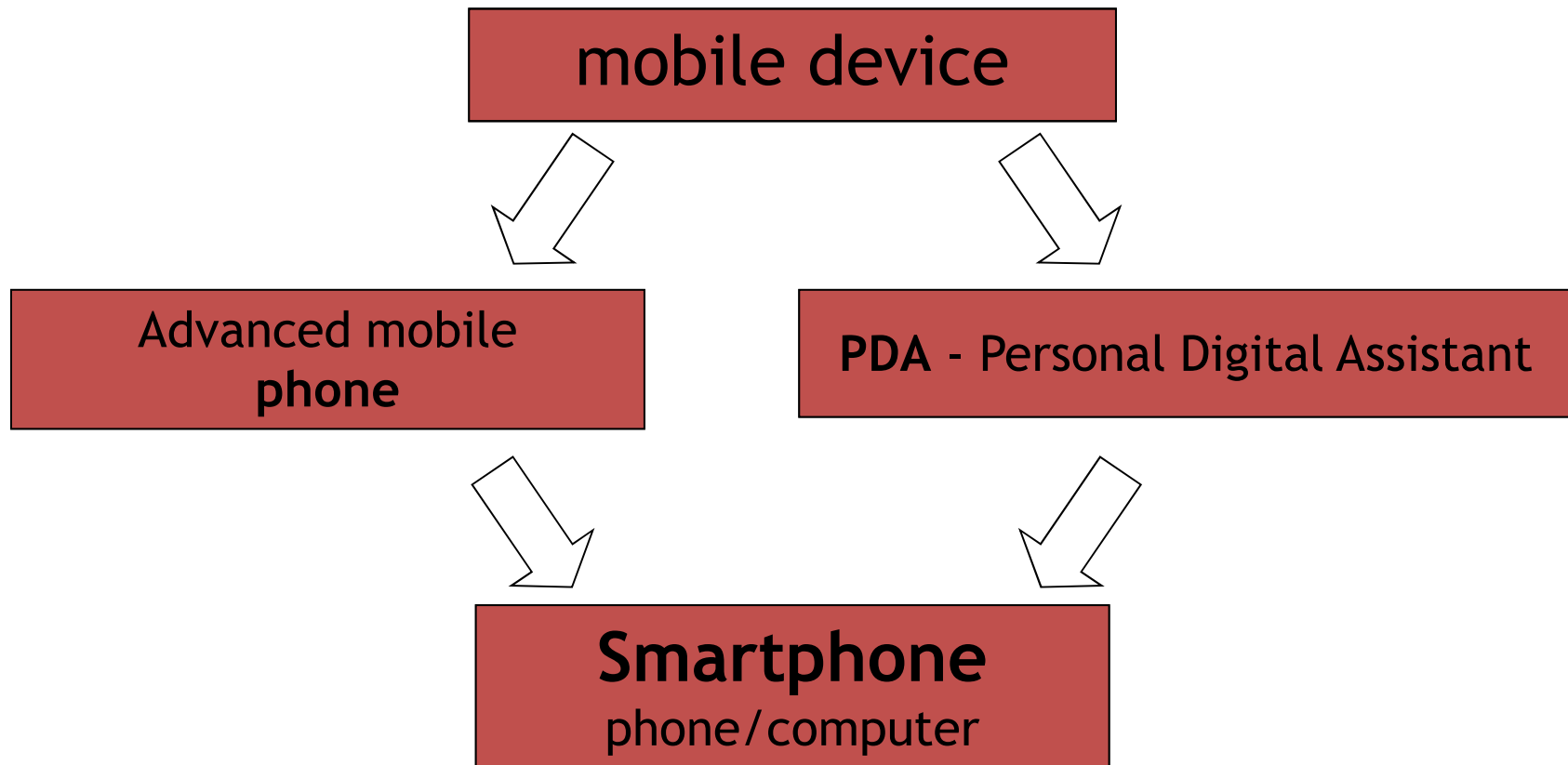Car-mounted phones

Transportable phones
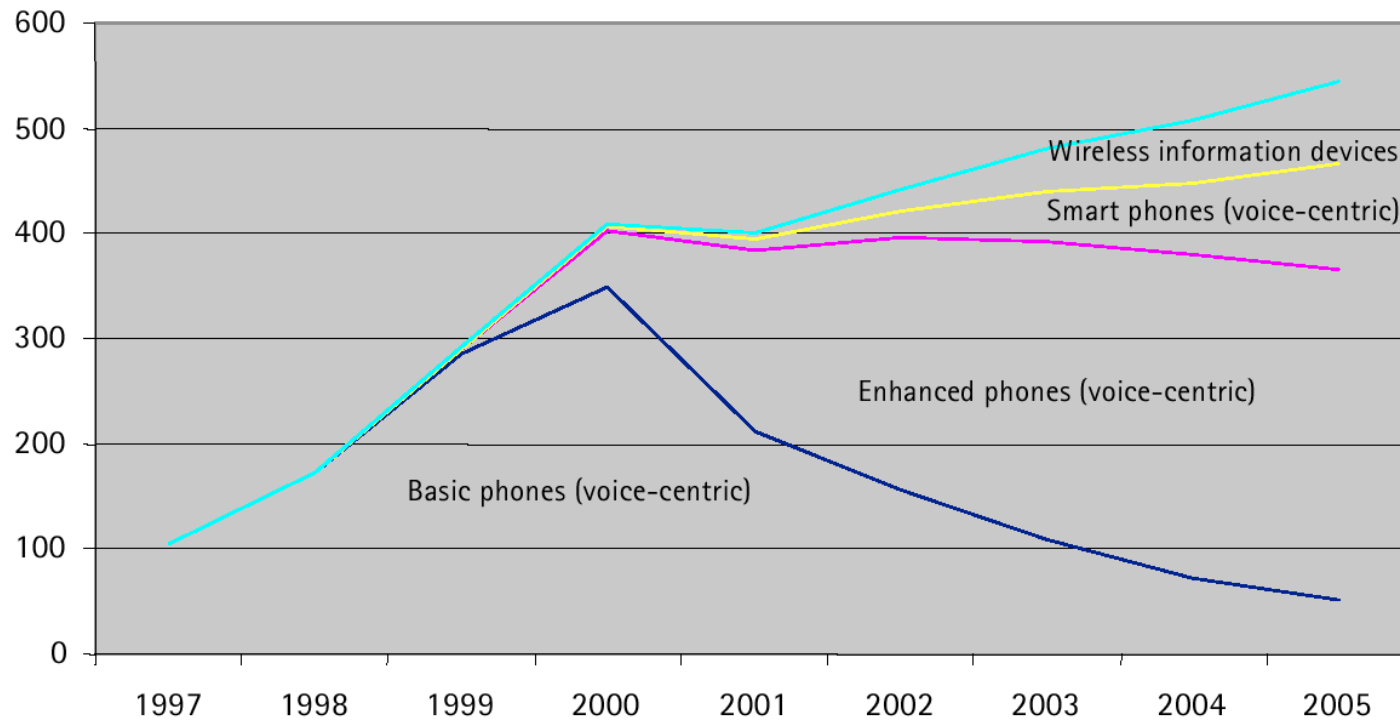
Handportable phones

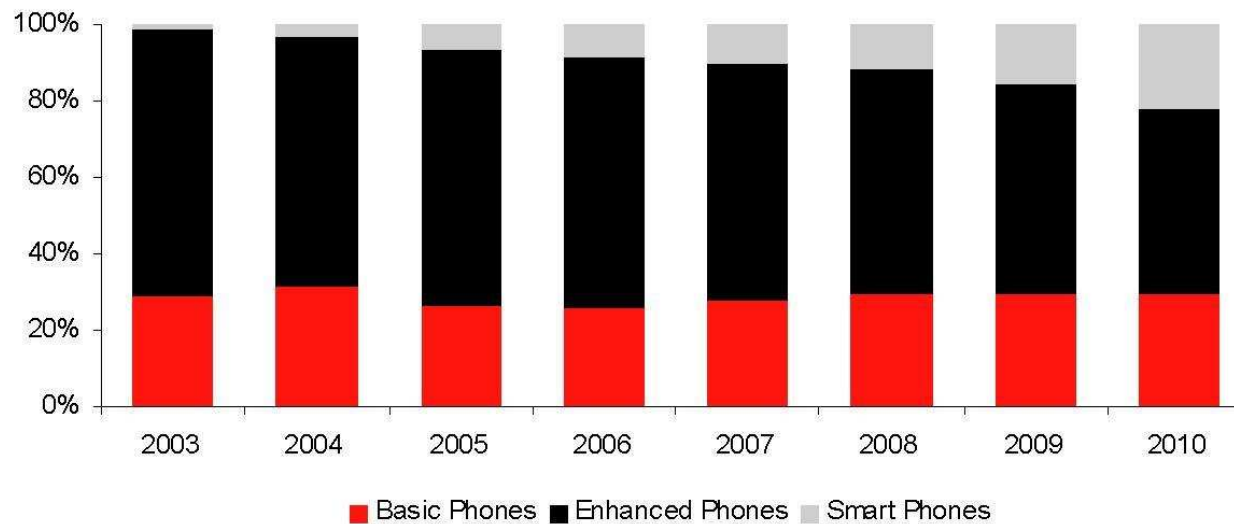Pocketable phones

Palm phones

What's now ?

mobile device

Advanced mobile **phone**

PDA - Personal Digital Assistant

Smartphone
phone/computer

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Sales forecast (2003)

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Sales reality (2009) - proportions

The handset sales pattern has become polarised between higher-end smartphones and low-cost basic devices

Source: Gartner Dataquest, Macquarie Research, February 2009

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Motivation (1): People Buy More Smart Phones than PCs !

Personal Computers, Sold

236M

↓ **31%**
(2009 compared to 2008)

Soon the number of smart phones will take over PC

Smart Phones, Sold

225M

↑ **28%** **(2009 compared to 2008)**

[Ref: Gartner , Competitive Landscape: Mobile Devices, Worldwide, 2Q09]

Motivation (2): Chaos - Multitude of Mobile Development Platforms

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Motivation (3): Trends in History

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Motivation (4): Explosive Integration

New Computing Cycle Characteristics
Reduce Usage Friction Via Better Processing Power + Improved User Interface + Smaller Form Factor + Lower Prices + Expanded Services = 10x More Devices
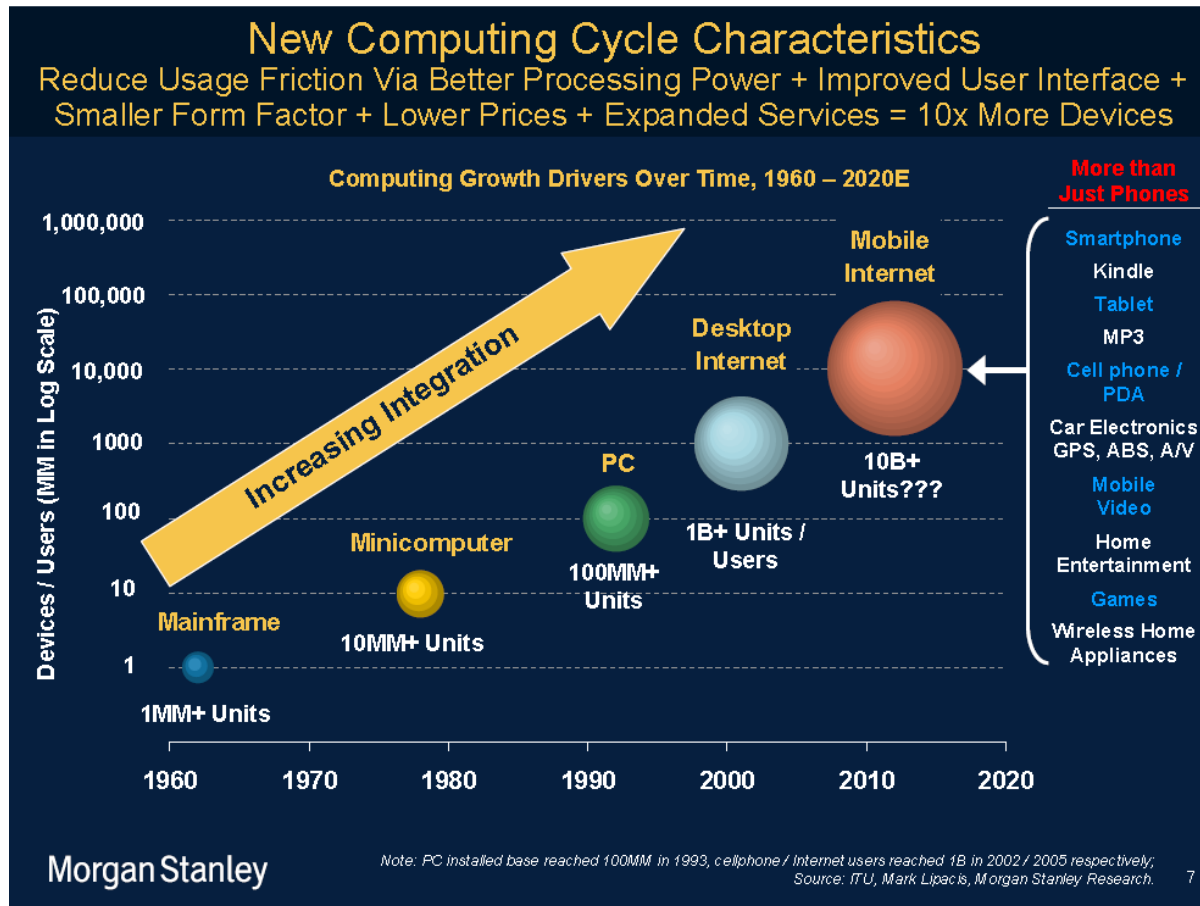
Mobile Devices as 7th Mass Media

The Seven Mass Media

First Mass Media Channel - *Print* from the 1500s

Second Mass Media Channel - *Recordings* from 1900s

Third Mass Media Channel - *Cinema* from 1910s

Fourth Mass Media Channel - *Radio* from 1920s

Fifth Mass Media Channel - *TV* from 1950s

Sixth Mass Media Channel - *Internet* from 1990s

Seventh Mass Media Channel - *Mobile* from 2000s

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Mobile Computing Definition (1)

➢ generic term describing one's
  ability to use technology while moving,
  (as opposed to portable computers, which are only practical for use
    while deployed in a stationary configuration).

➢ **Taking a computer** and all necessary files and software
  out into the field

➢ use technology 'untethered',
  that is **not physically connected**,

  or in remote or mobile (non static) environments

➢ Mobile computing **usually implies wireless transmission**,
  but wireless transmission does not necessarily imply mobile computing.

Mobile Computing Definition (2)

➢ The term is evolved in modern usage
such that it requires that the mobile computing activity
be connected wirelessly to and through the Internet
or to and through a private network.

➢ This connection ties the mobile device to centrally located information
and/or application software through the use of **battery powered**,
portable, and wireless computing and communication devices.

➢ This includes devices like laptops with wireless LAN or wireless WAN
technology, **smart mobile phones**, **wearable computers**
and **Personal Digital Assistants** with Bluetooth/IRDA interfaces.

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Mobile Computing Definition (3)

➢ any application in which the used
computing system is not assigned a specific location.

➢ In some cases the
movement of the system is an essential element
of the application; for example the system may be mounted in a vehicle,

➢ or may be used by someone whose work demands visits to different
locations with no on-site computing facilities.

➢ In other cases it is the end-user who may **move from place to place,
each equipped with computing facilities**,
along the way the user is able to use any network-connected workstation that will
automatically reconfigure itself reconstructing the environment which was used.

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Possible Dimensions of Mobility

- ➢ Mobile devices

- ➢ Mobile data

- ➢ Mobile code

- ➢ Mobile communication

- ➢ Mobile services

- ➢ Mobile context

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Constraints of Mobile Devices

- ➢ Memory and CPU performance

- ➢ Need to keep power consumption down

- ➢ Limited Bandwidth / Connection not always available

- ➢ Security

- ➢ User Interaction and Display
  - Smaller display
  - Different means of interactions

- ➢ A multitude of Operating Systems

Mobile Constraints:
(1) Fragmentation of Mobile Market

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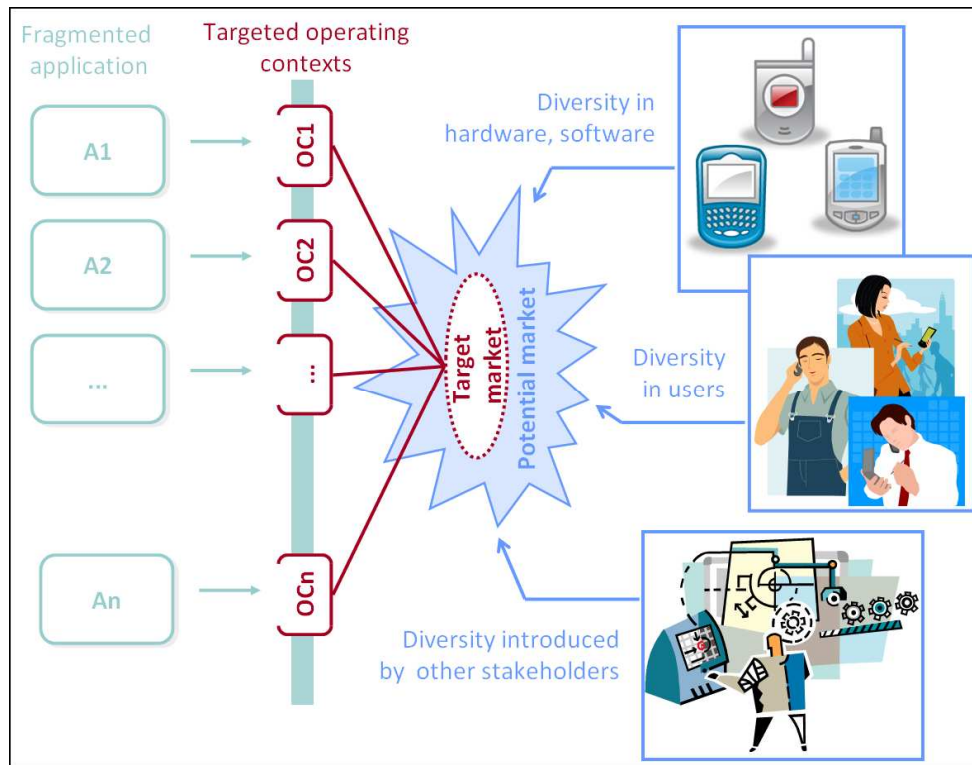
Mobile Constraints:
(2) User Input Interface

- Stylus / Pen

- On-screen Keyboard

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Ergonomics of a mobile devices

Device type	Phones	PDAs	Communicators	Wearables
Primary input mechanism	One-handed operation	One hand holds the device; the other operates the devices with a stylus or finger	Both hands hold the device; thumb typing with keyboard	Device is attached to body or clothing; one-handed use
Usage ergonomics				
Sample devices	Philips Fisio 820	Sony Ericsson P900	Nokia 9300 Communicator	Samsung Wristphone

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Mobile Constraints:
(3) User Output

➢ **Small screen size** – This makes it difficult or impossible to see text and graphics dependent on the standard size of a desktop computer screen

➢ **Lack of windows** – unsupported multiple windows in the same screen. On a desktop computer, the ability to open more than one window at a time allows for multi-tasking and for easy revert to the previous page.

➢ **Types of pages accessible** – Many sites that can be accessed on a desktop cannot on a mobile device (e.g. pages with a secured connection, Flash, PDFs, video sites, etc.)

➢ **Broken pages** – On many devices, a single page as viewed on a desktop is broken into segments, each of which is treated as a separate page. Paired with the slow speed, navigation between these pages is slow.

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Mobile Constraints:
(4) Wireless Connection

➢ Data transmission is a costly resource

➢ Connection in mobile environments is subject
  to different quality in different contexts

➢ Adapt to low connection quality, by employing:

  – Filtering – download only those elements that you require

  – Paging – download only those items (of an element) that you require

  – Caching – cache locally instead of requesting the same data

➢ Connection may not be always available

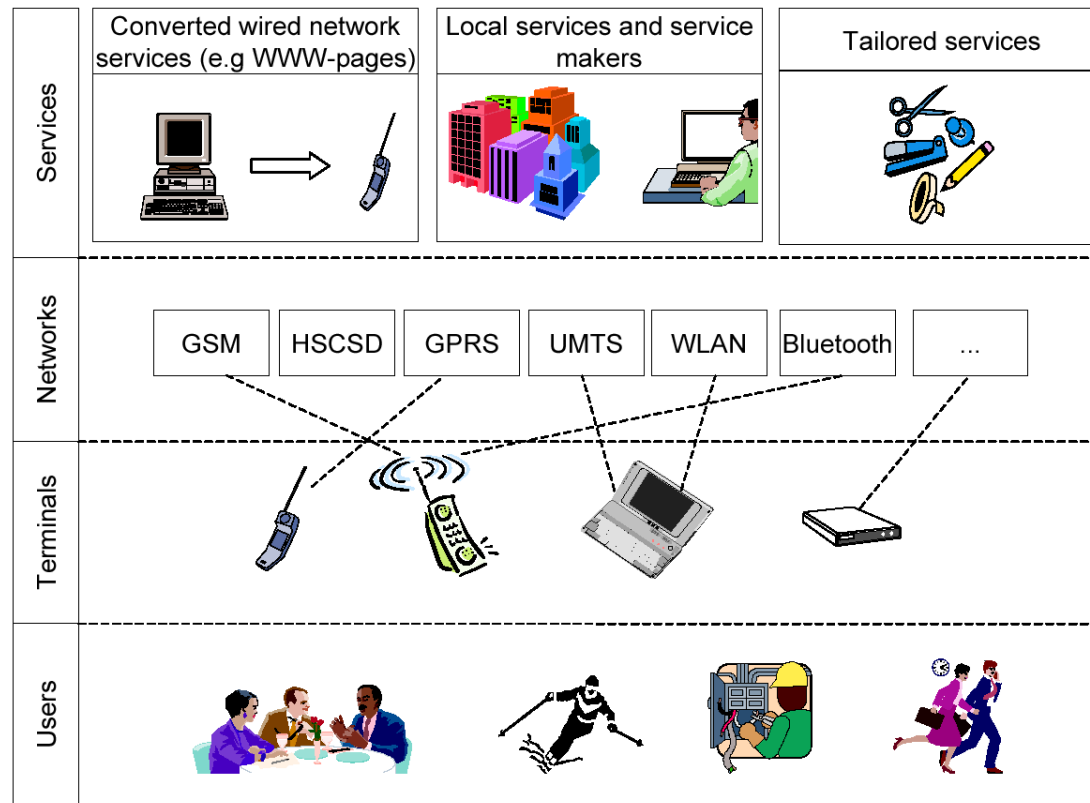 – Recovering from intermittent or lost connections is needed

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Mobile Constraints:
(5) Web Browsing

➢ Memory constrains → bigger pages could cause a crash

➢ No multi-document/multi-tab support

➢ No link target / current page saving

➢ Weak / non-existing Ajax/JavaScript support

➢ Java applets (login, authentication) restricted

➢ Desktop ActiveX not supported

➢ Flash incompatibility

➢ Poor CSS support

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Mobile environment

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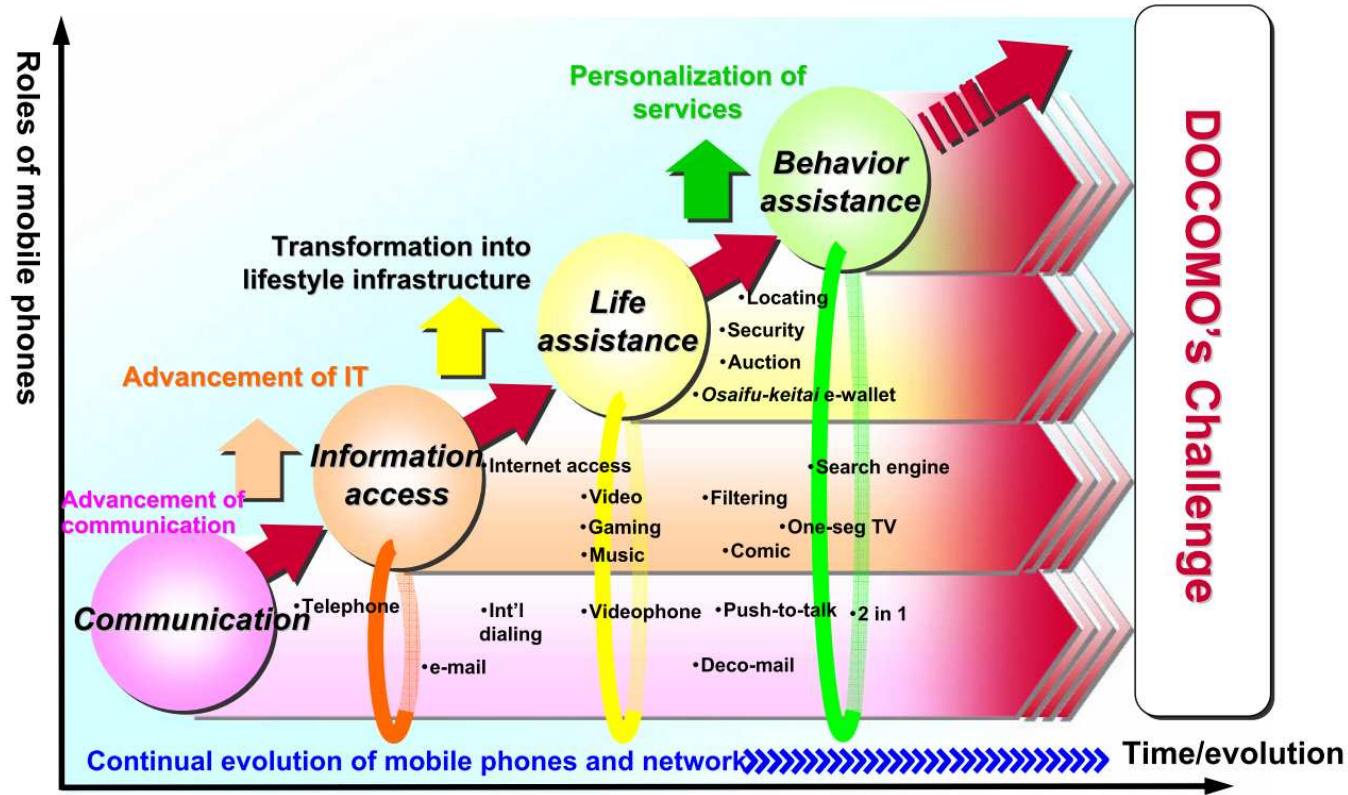
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NTT DOCOMO, INC. / Japan
World's leading mobile
communications company.
56 million customers in 2010

DOCOMO Vision
Evolving Role of Mobile Phone

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Example application (1)

Real Estate Industry

➤ Access to property information
- – Pictures / lot info / seller info / price / Showing schedule

➤ Real Estate applications
- – Mortgage calculator, etc.
- – Form in-fill info (applications)

➤ Sales Force Management
- – Appointment Management
- – Schedule visibility
- – Client information

➤ Web site Offer's Visualisation

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Example application (2)
FMPC Barcode PDA Solution

Example application (3)
Mobile Assistant for Tourist

Touristic map, computer database of hotels and resaturants

Calculation of a public transport connection, route planning

Example application (4)

Pharmacy - Drug Inventory Management

➢ Drug Inventory Stock Management (re-order)
➢ Minimize data entry error on drug code
➢ Drug Condition (expiration date)
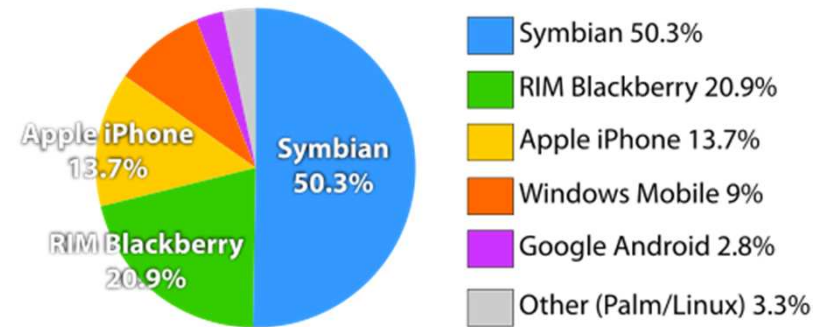➢ Drug order history
➢ Next arrival quantity

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Eight (Most Popular) Mobile Platforms

in alphabetical order

- ➢ Android
- ➢ BlackBerry
- ➢ Flash/Flash Lite
- ➢ iOS (iPhone),
- ➢ Java ME
- ➢ Symbian
- ➢ Windows Phone,
- ➢ mobile web (WAP/XHTML/CSS/JavaScript)

Global Smartphone Sales, Q2 2009

- Symbian 50.3%
- RIM Blackberry 20.9%
- Apple iPhone 13.7%
- Windows Mobile 9%
- Google Android 2.8%
- Other (Palm/Linux) 3.3%

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Advanced Mobile Devices
(smartphones/tablets)

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Mobile Java – J2ME (Sun)

<u>Advantages:</u>

- Former leader of mobile development community.
- Extensive market penetration (almost 100% phones)
- Can work on mobile devices with less than 1 MB of storage
- A popular option for creating games for mobile phones

<u>Disadvanatges:</u>

- No access to all of devices resources
- Not as fast as native code

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Symbian (Nokia)

Advantages:

- Most popular mobile operating system, accounting for about 50% of smartphone sales
- Symbian devices can also be programmed using Python, Java ME, Flash Lite, Ruby, .NET, Web Runtime (WRT) Widgets and Standard C/C++
- In 2009, Nokia started the Symbian Foundation, which will be an independent force for the future development of Symbian OS
- Native GUI, Access to native APIs, very good performance
- Being open source could help accelerate pace of innovation (like Android)

Disadvantages:

- Long learning curve,
- More difficult application distribution (in comparison to iPhone's app store)
- Limited market penetration in the US

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Windows Mobile (Microsoft)

Advantages:

- Large user base
- Interface similar to desktop versions of Windows OS
- Supports a variety of languages including:
  - Visual C++
  - Visual Basic .NET
  - Visual C# using .NET Compact Framework
- many applications on the market

Disadvantages:

- Current version on the market (WM6) lacks support for some popular technology enablers (e.g., multi-touch, GPS, accelerometer)
- Less developer enthusiasm vs. that for iPhone and Android
- Difficult application distribution (in comparison to iPhone's app store)

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Mobile .NET

Advantages:

— Microsoft's solutions come in a number of mobile flavors:
  - o Windows CE
  - o Window Mobile/Pocket PC
  - o Windows Tablet PC Edition

— Interface similar to popular desktop systems: Windows 2k, XP, Vista, 7

Disadvantages:

— Average market penetration
— The platform must support the Microsoft .NET Compact Framework runtime

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iPhone OS (Apple)

Advantages:

– Strong user growth and data-hungry user base

– Application store creating a vibrant app ecosystem with great momentum
More than 85K applications (~20% free), more than 1 million downloads

– Powerful technology enablers (e.g., multi-touch, GPS, accelerometer)

Disadvantages:

– App approval process is largely a black-box to developers

– Apps viewed as competitive to Apple are often shut down

– Downloads highly dependent on "featured" or "top download" promotion in store

– Apple / hardware dependent

– App store is the only authorized distribution channel

– If you plan on releasing application, you'll need to sign up
for the iPhone Developer Program

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BlackBerry OS (RIM)

Advantages:

- Large and data-hungry user base
- Blackberry Java Development Environment available for free
- Developers not limited to single distribution channel

Disadvantages:

- Only Java ME supported with some additional Blackberry-specific APIs
- Less popular outside of North America
- Users more email focused vs. web consuming iPhone users
- Developer momentum appears to be shifting to iPhone

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Android (Google)

Advantages:

− Open source → could help accelerate the pace of innovation

− Manufacturer-independent → could help accelerate consumer adoption

− New technology support (e.g., touchscreen, GPS, accelerometer, video and still cameras)

Disadvantages:

− Late to market relative to iPhone

− At least initially, demand is expected to trail iPhone demand

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Flash Lite (Macromedia)

Advantages:

– A lightweight version of popular Adobe Flash Player
– Easy converting of web-based (desktop) Flash content to mobile
– Rapid development. Like in normal Flash.
– Technology implemented at the client-side
– Packs more animation and graphics into the same file size

Disadvantages:

– Small market penetration, only a minority of phones
  offer support for Flash Lite.
– Relatively poor graphical performance
– Poor handling of sound

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Smartphone OS Competitive Landscape

	iPhone OS (Apple)	BlackBerry OS (RIM)	Window Mobile (Microsoft)	Android (Google)	Symbian (Nokia)
Platform	• Closed	• Closed	• Open	• Open	• Open
Source Code	• Closed	• Closed	• Closed	• Open	• Open (in future)
2009 WW Market Share [Gartner]	• 14.4%	• 19.9%	• 8.7%	• 3.9	• 46.9%
Smartphone traffic share [AdMob]	• WW: 46% • US: 39%	• WW: 5% • US: 7%	• WW: 1% • US: 1%	• WW: 25% • US: 46%	• WW: 21% • US: 1%
Pros	• Early momentum • Data hungry early adopters • Powerful distribution channel	• Strong reach (particularly in US)	• Manufacturer / carrier agnostic	• Manufacturer / carrier agnostic • Open source innovation	• Massive global reach • Open source innovation
Issues	• Apple dependant	• BlackBerry dependent • Distribution	• Distribution	• Late to market • Uncertain consumer demand	• Limited reach in US • Distribution
Application ecosystem [Distimo]	• iTunes Apps Store • >185K apps • More than 3B downloads	• BlackBerry App World • 5,5k apps	• Windows Marketplace • 1k apps	• Android Market • 50k apps	• OVI Market • 7k apps

Mobile Software Distribution

Fundamentals	Apple App Store	Android Market	Ovi Store	Handango	GetJar
Owner	Apple	Google	Nokia	Handango	Getjar Networks
Distribution model	via App Store on iPhone and iPod Touch	via Market on Android devices (closed source)	via download, and pre-loaded from 4Q09	via web mostly (direct + white label)	via web only (direct + white label)
Platforms	OSX	Android	S60, S40	Java, S60, RIM, WinMo, Palm, Android	Java, Flash, Android, RIM, WinMo, Palm, Android
Key figures					
Installed base of on-device storefront (2009 est.)	60M	5M	2M (preload on S60 + some S40 from 4Q09)	< 1M	0 (plans to pre-load icon shortcut on phones)
Downloads per month as of end of 2009 (est.)	200M	30M	5M	3M	50M
Applications to end of 2009 (est.)	110,000	16,000	4,000 apps 1,500 themes	140,000 apps	50,000 apps
Annual revenues (2009 est.)	$700M/year	$20M/year	N/A	N/A	N/A
Revenue model	70% to developer	70% to developer 30% optional to operator	70% to developer (less w/ carrier billing)	30-40% to developer + rev share to channel	Ad-based apps + paid placement

App Store comparative analysis (end- 2009). Source: VisionMobile

Some Technical Facts
from Real Life Practical Experience

➢ There's no big secret to mobile application development!

  – Languages are very similar to desktop (C / C++ / C#, Java / J2ME, ...)
  – Software life-cycles are essentially the same.

➢ Brute force testing on the device is the only assured way
of ensuring the apps work on the phones
(You can develop on emulators and it will work fine. Put it on a phone, it will fall over)

➢ No stdout or stderr stream for error output.

  – Need to draw on the screen.
  – Do as much as you can on the emulator!

➢ Testing → Don't use a high-end phone as your baseline!

  – Find the most restrictive devices you want your app on and do them first
  – You'll need two baseline phones for each screen size template
    • One with lowest CPU power
    • One with smallest memory

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Definitive Mobile Developer Survey

The most important figures from survey:

„Making sense of a fragmented world -
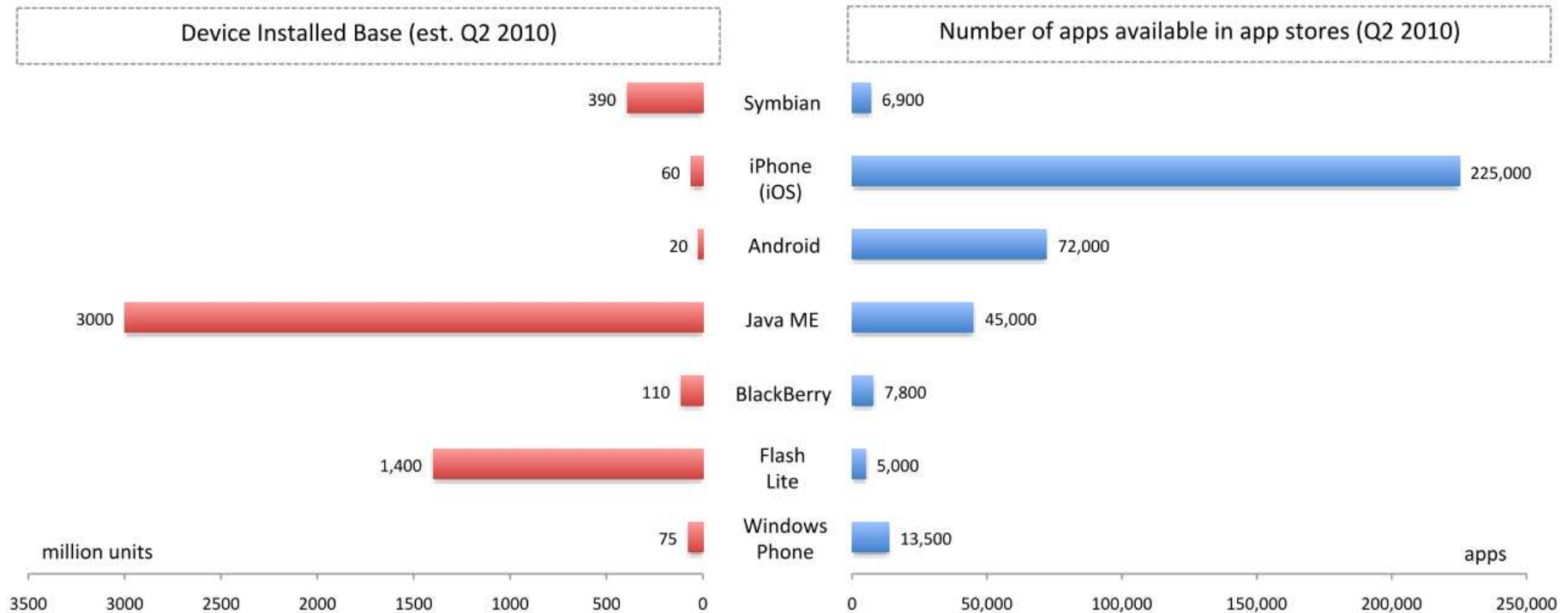## Mobile Developer Economics 2010 and Beyond"

by **VisionMobile**

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Quantity: Devices ↔ Applications

Device Installed Base (est. Q2 2010) | Number of apps available in app stores (Q2 2010)

Platform	Device Installed Base (million units)	Number of apps
Symbian	390	6,900
iPhone (iOS)	60	225,000
Android	20	72,000
Java ME	3000	45,000
BlackBerry	110	7,800
Flash Lite	1,400	5,000
Windows Phone	75	13,500

Source: Mobile Developer Economics 2010 and Beyond. Produced by VisionMobile. Sponsored by Telefonica Developer Communities.
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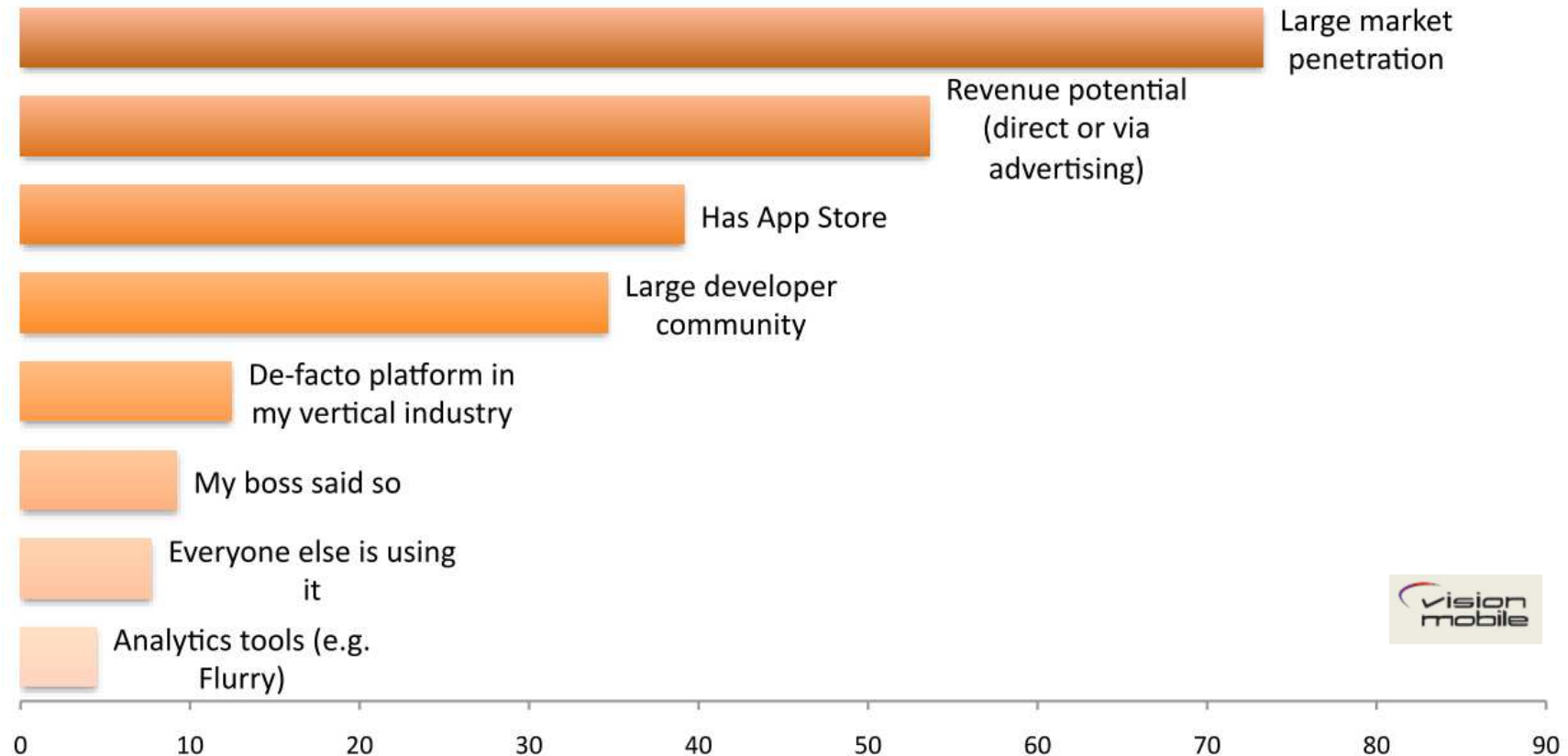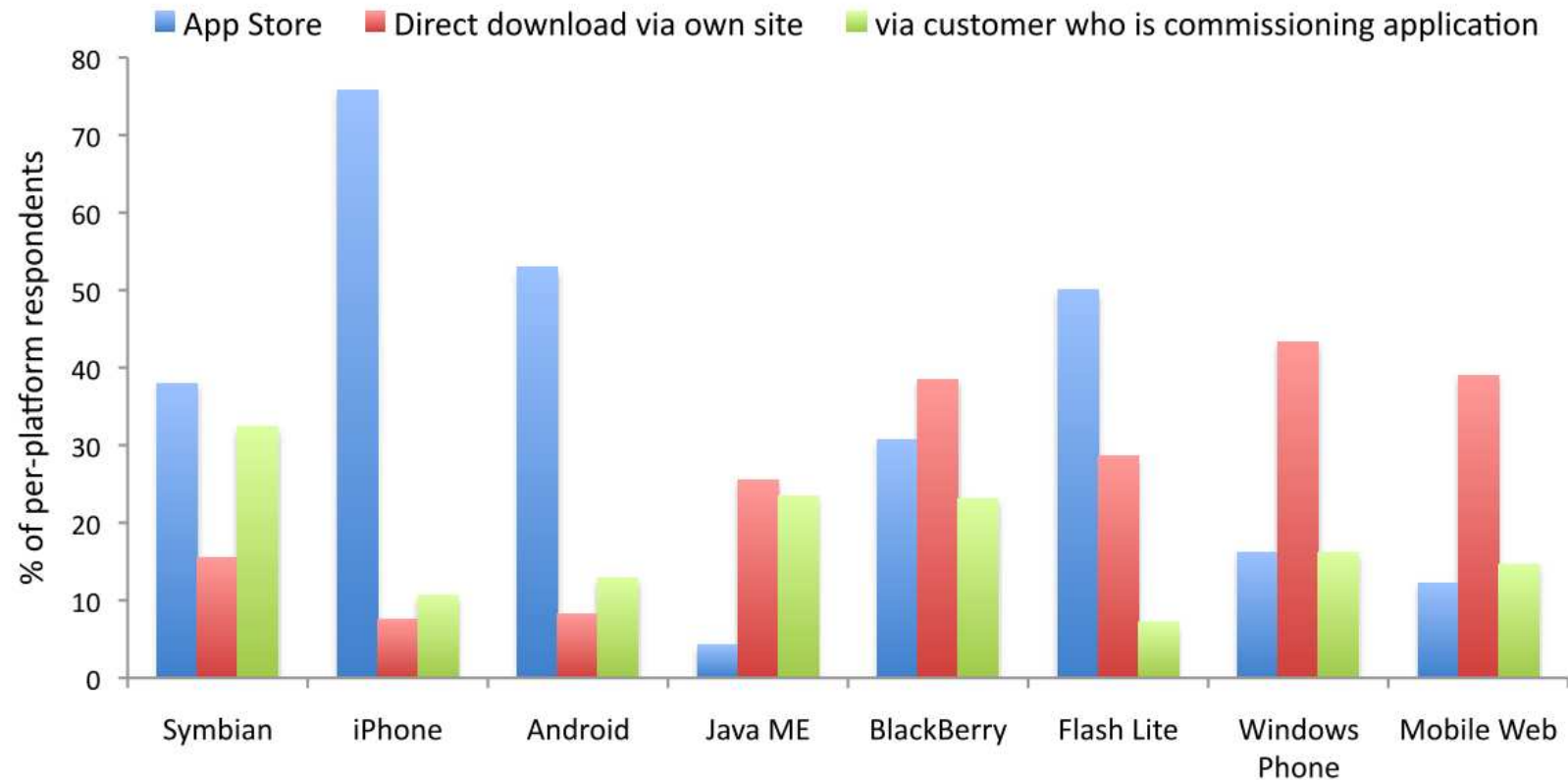
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Platforms most used by mobile developers in early 2010
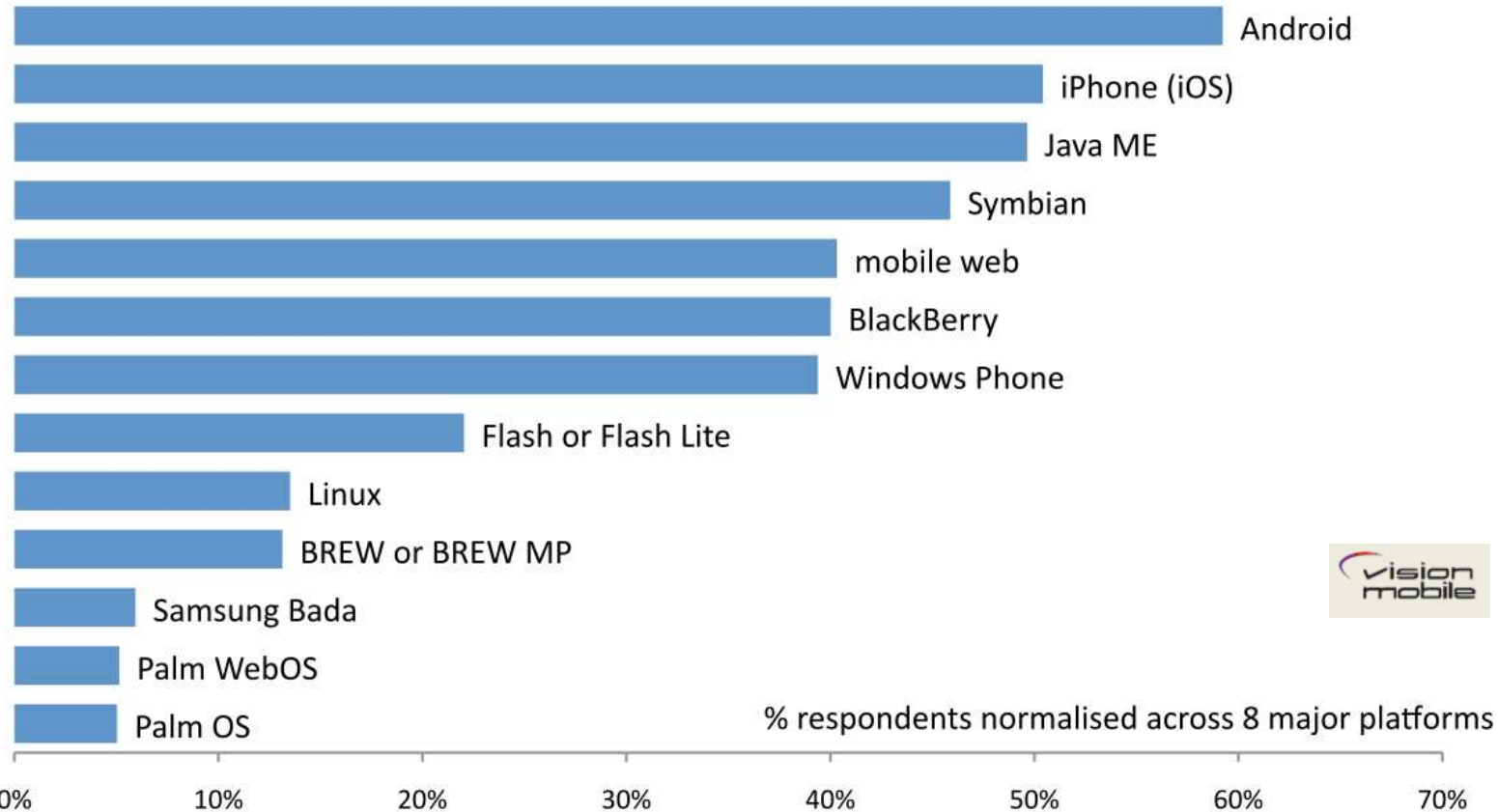
% respondents normalised across 8 major platforms

Bars (top to bottom): Android, iPhone (iOS), Java ME, Symbian, mobile web, BlackBerry, Windows Phone, Flash or Flash Lite, Linux, BREW or BREW MP, Samsung Bada, Palm WebOS, Palm OS

X-axis: 0%, 10%, 20%, 30%, 40%, 50%, 60%, 70%

Marketing reasons that mobile developers consider important in selecting a platform

Large market penetration — Revenue potential (direct or via advertising) — Has App Store — Large developer community — De-facto platform in my vertical industry — My boss said so — Everyone else is using it — Analytics tools (e.g. Flurry)

0 10 20 30 40 50 60 70 80 90

Main channels used by mobile developers to sell their apps (per platform)

Legend:
- App Store
- Direct download via own site
- via customer who is commissioning application

Time-to-market for apps (per channel)
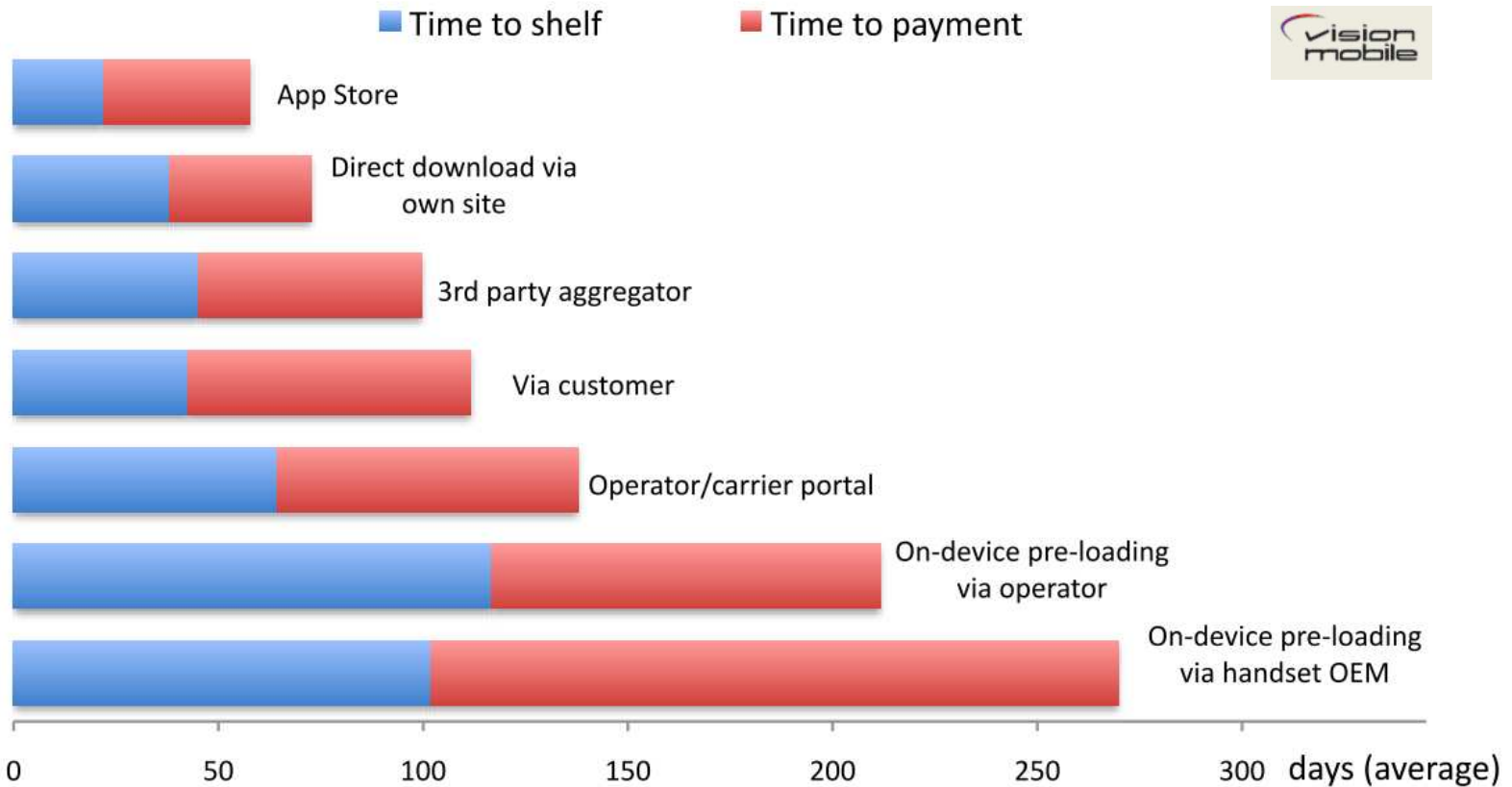
Legend: ■ Time to shelf ■ Time to payment

App Store
Direct download via own site
3rd party aggregator
Via customer
Operator/carrier portal
On-device pre-loading via operator
On-device pre-loading via handset OEM

0   50   100   150   200   250   300 days (average)

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Average time required to master each platform
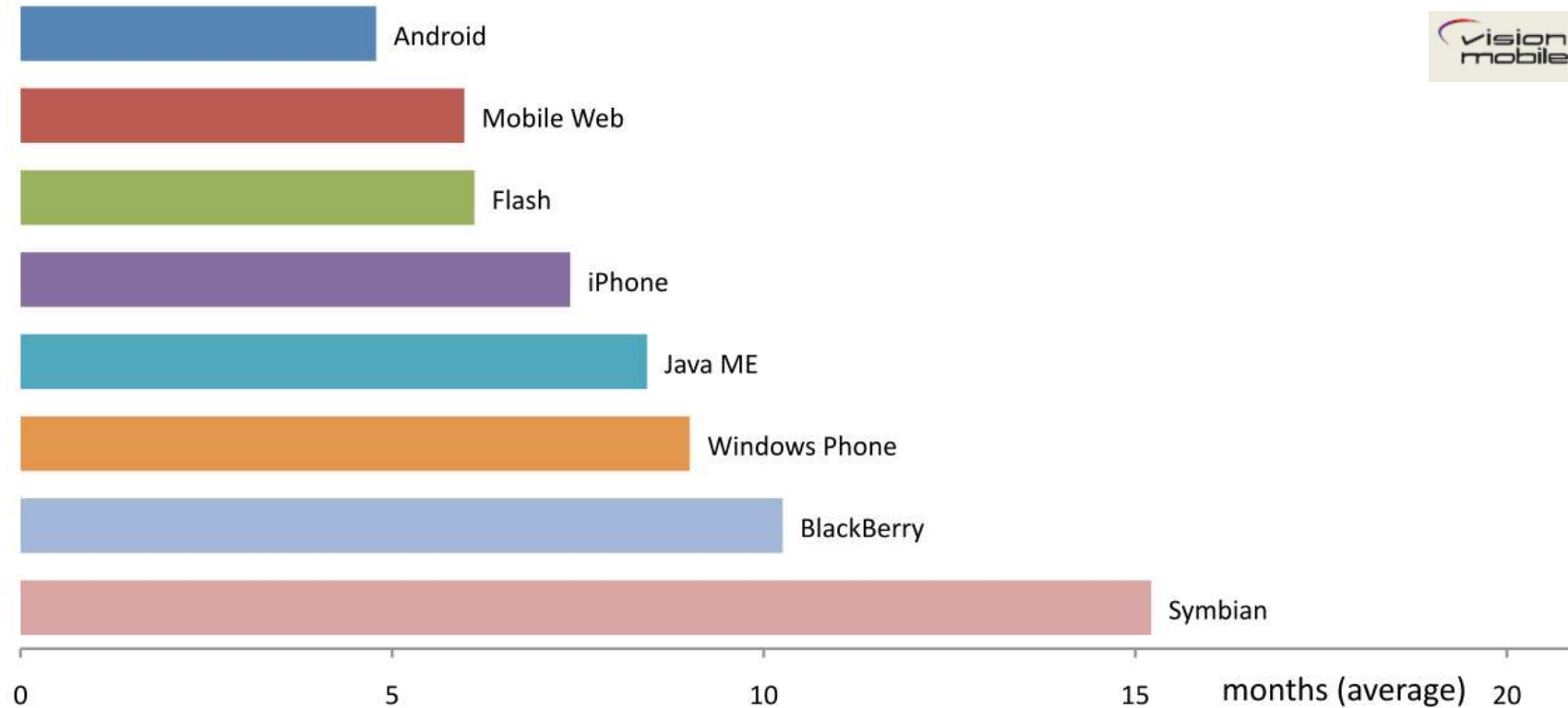
Android

Mobile Web

Flash

iPhone

Java ME

Windows Phone

BlackBerry

Symbian

vision
mobile

0   5   10   15   months (average)   20

Total development time per application

vision mobile

- ■ Hello World + Setup
- ■ Multimedia Player
- ■ Form controls and persistence
- ■ Camera snapshot
- ■ Location Sensing
- ■ Accelerometer
- ■ Network Access & Markup
- ■ Address Book & Telephony

hours

Source: Mobile Developer Economics 2010 and Beyond. Produced by VisionMobile. Sponsored by Telefonica Developer Communities. June 2010. Licensed under Creative Commons Attribution 3.0 License. Any use or remix of this work must retain this notice.
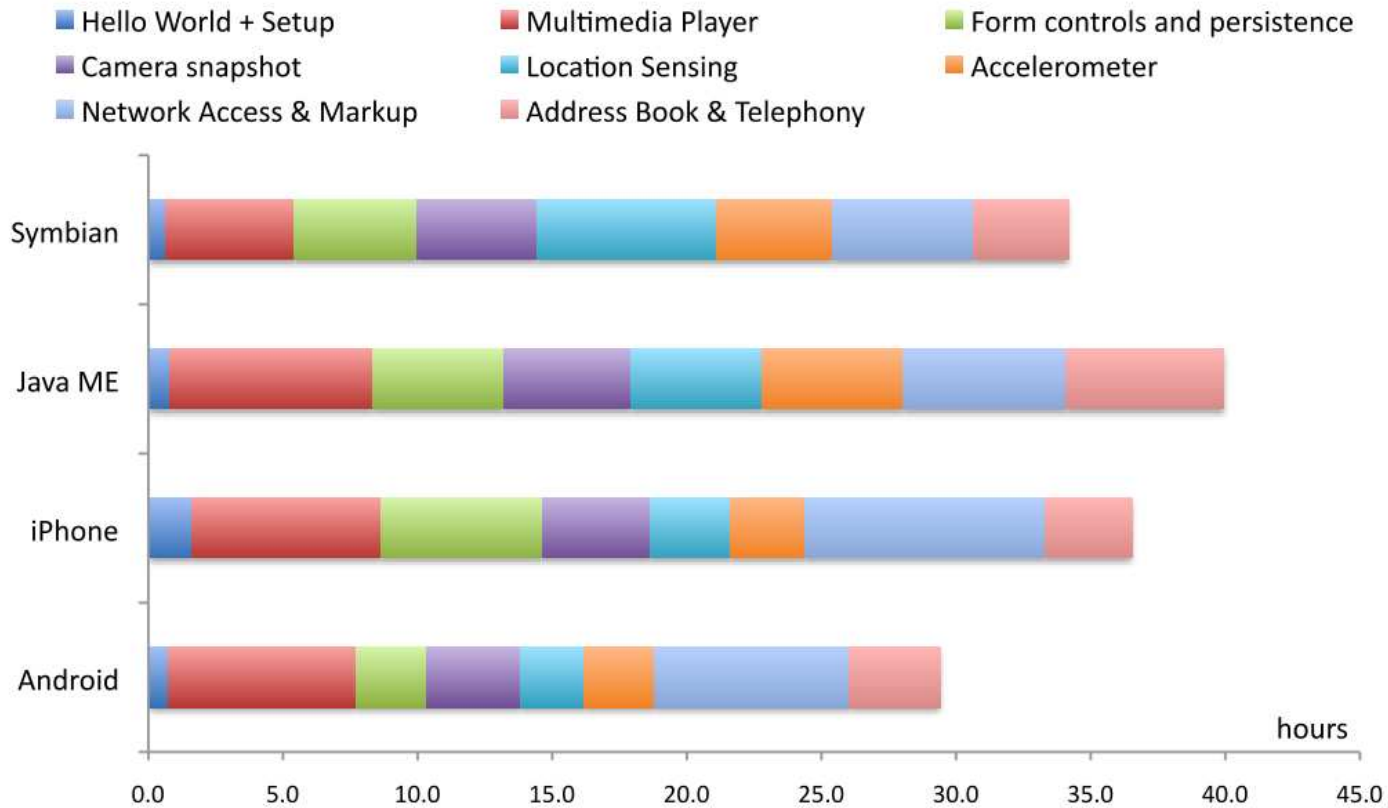
Geographical Distribution of 400 Respondents of Survey

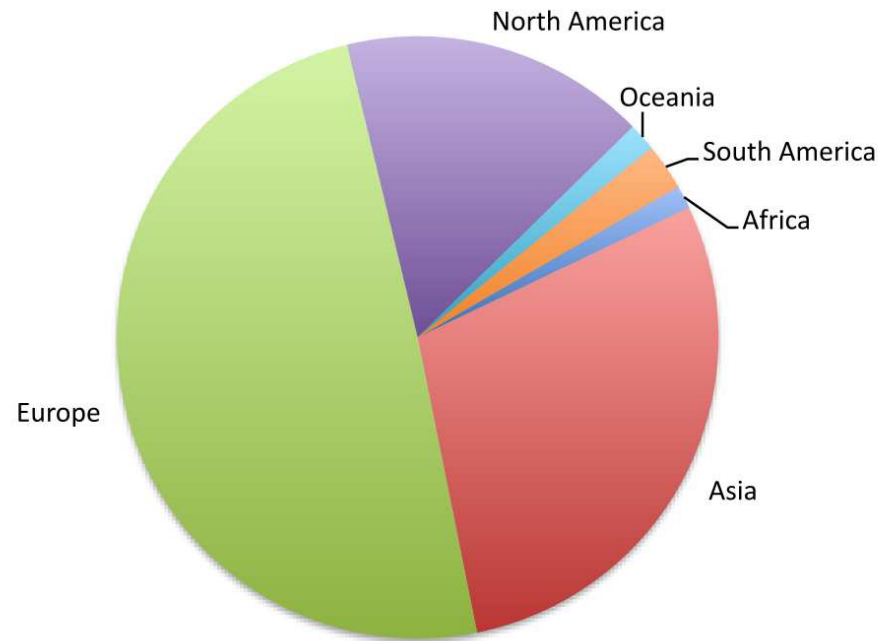| Top-10 countries	
Country	Respondents
India	56
UK	55
USA	43
Germany	29
Canada	21
France	18
Israel	16
Spain	16
China	12
Greece	10

Source: Mobile Developer Economics 2010 and Beyond. Produced by VisionMobile. Sponsored by Telefonica Developer Communities. June 2010. Licensed under Creative Commons Attribution 3.0 License. Any use or remix of this work must retain this notice.

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Sumary

➢ the new era of mobile technology is coming

➢ mobile computing: definitions, characteristics, constraints, applications

➢ several mobile platforms – there isn't evident leader

➢ unbalanced relation: devices ↔ applications

➢ various channels for software distribution

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