

TAXONOMY FOR MOBILE TERMINALS

A Selective Classification Scheme

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Abstract: There is a great number of different types of mobile computing devices like cellular phones, Handhelds and notebooks. However in literature so far there is no common accepted definition for these terminal types. Especially the term "Smartphone" is used for very different types of mobile phones. In our article we therefore propose a comprehensive taxonomy for mobile terminals that clearly distinguishes between different classes of terminals.

1 MOBILE TERMINALS

Everyday life without mobile terminals is almost unthinkable. With the increasing use of them for a multiplicity of tasks the equipment variants increase likewise. At present the most popular mobile terminals with the highest penetrations rates are mobile phones and Feature Phones. According to Kuhn (Kuhn, 2004) a mobile terminal is a portable computer-assisted communication system with independent data processing capacity, which can communicate as endpoint of a wireless connection with other IT-systems. "Independent data processing capacity" means that the mobile terminal is equipped with random access memory (RAM), a central processing unit (CPU) (this implies programmability), own network-independent power supply (battery) and the possibility to directly interact with human users by providing means for data input (e.g. keys, microphone, touchscreen) as well data output (e.g. display, light emitting diodes, speaker). Thus radio frequency identity tags (RFID), Smartcard etc. are not mobile terminals in the sense of the above definition because they don't dispose over an independent power supply and a user interface. Computers integrated into machines (e.g. vending machines, machines in factories) are also not considered as mobile terminals because a human user can't carry them along.

Mobile terminals differ particularly with regard to their size, their use and their performance for the execution of mobile applications. One reason for this

is that mobile computing is a rather new technology so a market consolidation like that for personal desktop computers didn't take place yet. There are also many application scenarios for mobile computers with different requirements so it is necessary to have mobile terminals especially developed for individual fields of applications. To get an impression of the great variety of mobile terminals one can refer to the WURFL¹ project which assembles a profile database with information about capabilities of different mobile terminals: the file comprehends over 5.000 different profiles. Some software products for mobile terminals are available in customized versions for several hundred types of mobile terminals, e.g. "Yahoo!Go"² a mobile applications that provides access to services like e-mail, news, weather forecasts and maps.

Nevertheless we can identify distinct classes of mobile terminals with common characteristics.

2 CLASSES OF TERMINALS

Within the range of the mobile terminals there are a number of different types. They differ in the characteristics listed above. There are different approaches to divide the terminals into different classes (see for example (Noesekabel and Lehner, 2002), (Meier, 2002) or (Roth, 2005)). The borders between the

¹ <http://wurfl.sourceforge.net/>

² <http://mobile.yahoo.com/go>

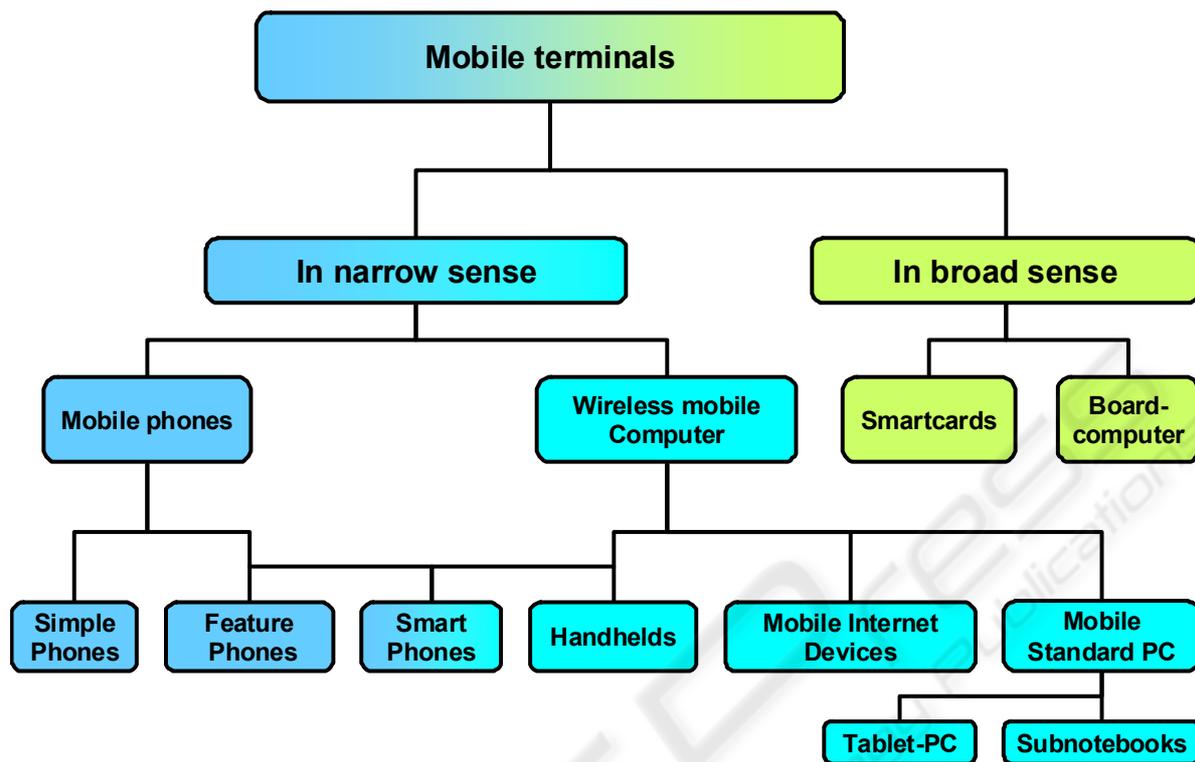


Figure 1: Classification tree of mobile terminals.

different terminal classes are seen differently by different authors and are often not clear. For example according to Brome and Zeman (Brome and Zeman, 2008) and Canalys (Canalys.com, 2004) the classification into Feature Phone and Smartphone is determined by whether additional software is executed directly by the operating system or by a runtime environment like Java ME. On the one hand this distinction isn't obvious, on the other hand there are terminals which can do both.

Mobile terminals can differ in the following criteria (list is not complete):

- Size and weight
- Input modes
- Output modes
- Performance
- Kind of usage
- Communication capabilities
- Type of operating system
- Expandability

Some of these characteristics can be used to distinguish classes of terminals from each other. The following section gives criteria for the classification of mobile terminals into distinct classes without the need to do a deepened technical analysis. All classes

regarded in our classification (see also Figure 1) have the ability for bidirectional wireless communication and have an independent power in the form of an accumulator. Hereby the often vague defined term Smartphone will be clearly separated from Feature Phone and Handheld.

2.1 Mobile Standard PC

The wireless mobile standard computers include laptops/notebooks, subnotebooks (also called netbooks) and Tablet-PC (including ultra mobile PC (UMPC)). Subnotebook is the name for a particularly small and light notebook, whose equipment is very similar to those in a full notebook, however has no optical drives (CD/DVD-ROM-drive) and a smaller keyboard. An UMPC is a Tablet-PC which is maximally 8 inches large, weighs maximally 900 grams and has a display with a resolution of at least 800x480 pixels; Keyboards can be attached externally. On these terminals the conventional desktop operating systems (Linux, Windows) can be used as well as the compatible software packages like office suites. Substantial distinguishing features are the size of chassis and display, the weight, the

integrated peripherals (e.g. optical Drive included) and the operation kind of the terminals.

Notebooks with wireless communication capabilities are mobile terminals according to definition given above. However in the following considerations we won't focus on them because our article is more concerned with smaller and lighter terminals that can be used by a walking or standing user. Notebooks usually need a „stand space“ like a table or someone's lap. Tablet PCs on the other hand are a special subclass of the mobile standard computers, because they have a touch-sensitive display and therefore can be used while standing with only one hand so they can be operated without a stand space.

2.2 Mobile Internet Devices

Beside the mobile standard PC there is a terminal class "Mobile Internet Devices" (MID) (also called Web-Tablet or mobile Thin Client) with similar equipment and display size, however clearly reduced function range and normally no mechanical drives. Characteristically these terminals are equipped like Handhelds (see below) with an operating system in the read-only memory (ROM) and are immediately ready for use after switching them on. Their function range is similar to the Handhelds and they are mainly used for browsing the web and as client for terminal server sessions. They depend mostly on a constant wireless network connection for the fulfilment of their tasks. The Web-Tablets (like the Tablet PC) can be operated through a touch-sensitive display, the mobile Thin Clients usually through a keyboard.

2.3 Handhelds

Handhelds are small computers, which — like the name already suggest — can be held in one hand. They are called often also Personal Digital Assistant (PDA). Historically these were originated from the pure organizers, which could be predominantly used for personal information management (PIM) applications like calendar, address book or personal notes. Today's Handhelds have clearly higher performance and are usually equipped with multimedia capabilities. As written above, only Handhelds who are able to establish a wireless connection are regarded here. They are equipped usually with an operating system in the ROM and are immediately ready for use after switching on (no boot-time needed). Apart from the pre-installed programs in the ROM, users can install further applications in the RAM or the flash memory and attach various exten-

sion modules. Handhelds usually have a touch-sensitive display and can be used with a pen (or the fingers), or they have a text keyboard and navigation keys for it. Increasingly there are terminals which can be operated through both of them. Terminals are only classified as Handheld if they cannot communicate in communication networks for mobile telephony like GSM or UMTS.

2.4 Smartphones

The term "Smartphone" designates a combination of Feature Phone (see below) and Handheld with usually somewhat smaller dimensions, smaller display and partly reduced function range in comparison to the Handheld. They form their own class. On the one hand mobile computers which have the characteristics of Handhelds and the ability to communication over mobile telephony networks and have almost everywhere and „seamless“³ connection to the Internet belong to this class. On the other hand portable radio terminals with the characteristics of Feature Phones that have extended input modes belong to this class, too. The extended input mode can be provided by a touch-sensitive display (which can be used with the fingers or a pen) or a complete text keyboard.

2.5 Feature Phones

Feature Phones are mobile phones (see below) with usually somewhat larger display and extended function range. The primary use purpose of the Feature Phones lies in mobile communication, which includes both the voice communication and text-based communication (SMS, MMS, e-mail etc.). For this terminal class the ability for wireless data communication over the mobile communications networks (e.g. GPRS or UMTS) and the absence of the extended input modes are characteristic. These are limited to a number keyboard and a few additional keys. Particularly terminals which support not only the GSM standard but also UMTS are equipped with a Web browser and software to play back multimedia contents. On these terminals the user can install additional software. Since many terminals have proprietary operating systems, in most cases additional software is offered on basis of Java Micro

³ Seamless means that these terminals change unnoticed and without further user interaction independently from one radio cell to another (soft handover) and give the user the impression of only one large radio cell.

Edition (Java ME), which is supported by nearly every Feature Phone manufactured today.

2.6 Simple Phones

The classical mobile phones (also termed “cellular phone”) were developed primarily for mere voice communication. However nowadays text-based communication in the form of the short message service (SMS) is a standard feature of mobile phones. For Simple Phones it is characteristic that they are not able to use wireless data communication based on TCP/IP (e.g. browsing the internet or receive e-mail). The resolution and colour depth provided by displays of these terminals was significantly improved in the recent years. The displays became also bigger but they are usually noticeably smaller than those of Feature Phones. The function range of these terminals can only be extended with software in a small scale, e.g. by additional ringtones, pictures and multimedia animations or games, whereby these are strongly limited by the memory free space and the performance of the processor.

2.7 Special Terminals

Beyond the versatile usable standard terminals there are a number of specialized mobile terminals which cannot be arranged into the above classification. These are for example e-book readers for storage and reproduction of electronic books, electronic light pens, which can read bar code or printed texts and process electronically or bar code readers with number keyboard for the stocktaking in supermarkets: A worker scans the product code, enters the number of available products in shelf and transfers all immediately wirelessly to a server.

Navigation terminals for travellers became quite popular in the last few years. Those terminals can be used for locating as well as for route guidance. These terminals can calculate their own position based on the signals received from several satellites (Küpper, 2005). The global positioning system (GPS) of the US military or the Russian system GLONASS are already in use for many years and can be used nearly world-wide without fees. The projected Galileo system by the European Union is a civilian system that will provide some service for navigation free of charge; the full operation of this system is now scheduled to start in the year 2013. GPS (ore others) receivers can be integrated into a mobile terminal but there are also separate GPS modules (so called “GPS mouse”) that can be con-

nected to a mobile terminal using a cable or bluetooth.

3 CONCLUSIONS

In this article we distinguished the mobile terminals clearly from other mobile devices. With the introduction of the term Feature Phone, which is used rarely by other authors, mobile phones can be divided selectively into different classes. The term Smartphone, which was until then fuzzy, become consequently clear. With the introduction of the class of special terminals, which comprehends all terminals for special tasks that cannot and should not be assigned to the standard classes, the classification of mobile terminals is altogether clear and complete.

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