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Bluetooth™

Whitepaper



Summary

The number of computing and telecommunications devices is increasing and consequently, the focus on how to connect them to each other. The usual solution is to connect the devices with a cable to make file transfer and synchronisation possible. File transfer is required so that the user is able to type a document in, for instance, a PDA and move it later to the PC. There is also a need for synchronisation of events in the calendars of the various devices. The solution to these requirements has been to connect the devices with a cable, or sometimes to connect them using infrared light.

The cable solution is often complicated since it may require a cable specific to the devices being connected as well as configuration software. The infrared solution eliminates the cable, but requires line of sight. To solve these problems a new technology, Bluetooth, has been developed. Bluetooth provides the means for a short-range radio link solution. It is the result of a co-operative effort among a number of companies all working for a cheap, simple, and low power-consuming solution with broad market support.

With Bluetooth, users will be able to connect a wide range of computing and telecommunications devices easily and simply, without the need for connecting cables. The technology defines how units can communicate up to 10 meters from each other. It also defines how certain applications should be mapped onto the hardware to be compatible with Bluetooth. If this is achieved, the concept ensures that devices can operate with other Bluetooth applications and devices regardless of manufacturer. The concept can also act as a way to avoid cable solutions. Furthermore, it can also be used to enable communication between several units, such as small radio LANs. This results in a multitude of possible future user scenarios.

The strength of the Bluetooth concept is that Bluetooth chips can be made very small; they are cheap and they are low power-consuming. Furthermore, there is support for the technique from a vast variety of companies. It is supported not only in the PC and mobile phone industries, but also in several other industries as well.

Introduction

This Bluetooth white paper aims to give a good overview of the Bluetooth concept. It strives to cover technical aspects, regarding hardware, software and Bluetooth applications. It also deals with marketing aspects in relation to competing techniques. Furthermore, it describes some of the companies behind Bluetooth and some of their motives.

The document begins with an introduction where the Bluetooth background and the Bluetooth standardisation organisation are described. What benefits and possibilities the technology can provide to users are handled in the section Bluetooth – Cable replacement, and more. This section also gives a view of the marketing position that the Bluetooth technology enters. The Bluetooth protocol layers and their configuration is described in the section Bluetooth architecture. It A section describing the Bluetooth air interface follows it. Competing techniques and the strengths with the Bluetooth concept is then handled in the section Why Bluetooth – Technical aspects. Finally, a brief look at the near Bluetooth future is done in the last section.

Background

Bluetooth technology and standards provide the means for the replacement of cable that connects one device to another with a universal short-range radio link. The technology was initially developed for replacing cables, but has now evolved into not only being a cable replacement technique but also a technique to establish connection between several units. For instance, it shows how to create small radio LANs.

A study was initiated at Ericsson Mobile Communications in 1994 to find a low power and low cost radio interface between mobile phones and their accessories. The requirements regarding price, capacity and size were set so that the new technique would have the potential to outdo all cable solutions between mobile devices. Initially a suitable radio interface with a corresponding frequency range had to be specified. A number of criteria for the concept were defined regarding size, capacity and global uniformity. The radio unit should be so small and consume such low power that it could be fitted into portable devices with their limitations. The concept had to handle both speech and data and finally the technique had to work all around the world.

The study soon showed that a short-range radio link solution was feasible. When designers at Ericsson had started to work on a transceiver chip, Ericsson soon realised that they needed companions to develop the technique. The associates strove not only to improve the technical solutions but also to get a solid and broad market support in the business areas of PC hardware, portable computers and mobile phones. Fear for a market situation with a multitude of non-standard cable solutions, where one cable is designed specifically for one pair of devices, was one of the motives that made competing companies join the project.

Ericsson Mobile Communications, Intel, IBM, Toshiba and Nokia Mobile Phones formed a Special Interest Group (SIG) in 1998. This group represented the diverse market support that was needed to generate good support for the new

technology. In May of the same year, the Bluetooth consortium announced itself globally. The intention of the Bluetooth SIG is to form a de facto standard for the air interface and the software that controls it. The purpose is to achieve interoperability between different devices from different producers of portable computers, mobile phones and other devices.

The name Bluetooth comes from a Danish Viking and King, Harald Blåtand (Bluetooth in English), who lived in the latter part of the 10th century. Harald Blåtand united and controlled Denmark and Norway.

Bluetooth SIG

In February 1998, the Bluetooth Special Interest Group, SIG, was founded. At the start, it consisted of the five companies mentioned above. Today more than 1300 companies have joined the SIG to work for an open standard for the Bluetooth concept. By signing a zero cost agreement, companies can join the SIG and qualify for a royalty-free licence to build products based on the Bluetooth technology.

To avoid different interpretations of the Bluetooth standard regarding how a specific type of application should be mapped to Bluetooth, the SIG has defined a number of user models and protocol profiles. These are described in more detail in the section entitled Bluetooth Usage Models and Profiles.

The SIG also works with a Qualification Process. This process defines criteria for Bluetooth product qualification that ensures that products that pass this process meet the Bluetooth specification.

Why Bluetooth – Marketing aspects

The removal of the cable connections between the mobile phone and its accessories was the origin of the Bluetooth concept. A computer connected to a keyboard, a mouse, a pair of loudspeakers, a PDA and so on, is a situation where a cordless solution would be useful. The need for different devices to be placed beside each other can also be eliminated. Instead, the location of devices is suddenly only limited by where to get the power supply.

Another motive for the Bluetooth technology is the problems with connecting and configuring mobile devices. To connect a new device a cable is needed, often specific to the brand of the device. When the physical connection is established a complicated configuration of the connection often follows. With existing cable replacement techniques, the security of the data transmission is insufficient. These difficulties are also addressed in the development of the Bluetooth technique.

The introduction of the Nokia Communicator 9000 has also been described as an event that increased interest in Bluetooth development. The Communicator reduced the complexity of connecting a mobile phone with a computer by building a two-in-one unit to solve the problem. It showed that one of the simplest ways to run data traffic via GSM was to buy a Communicator and not to buy a GSM Data interface card with cables matching both the phone and the portable computer. The combination of two devices in one was seen as a threat to the major manufacturers of portable PCs [1]. What if people started to buy communicators from mobile phone manufacturers instead of portable PCs from IBM or Toshiba? Furthermore, the introduction of Communicators "would impact sales of central processors for chip supplier Intel which dominates the PC market but doesn't have a competitive product for the likes of intelligent phones or handheld PCs" [1]. Hence, a development where the strong market position for portable PCs is maintained, is essential for the PC industry.

Other motives for a new cable replacement technique are [2]:

- The number of users of portable PCs is increasing. This implies a larger market for cordless connection of devices.
- The constant shrinking of portable PCs has led to solutions where devices, e.g. CD-ROM drives, are external and need to be connected smoothly to the PC.
- "Mobile computers now rival desktop systems in performance" [2]. The need for a stationary PC at the office *and* a portable PC for travelling is decreasing.

The Bluetooth technique provides a solution to the problems described above. The solution eliminates the annoying cable and its limitations regarding flexibility (often specific for a brand or pair of devices) and range. But, Bluetooth implies more than that. The technique provides the means for connecting several units to each other such as setting up small radio LANs between any types of

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