NEXT GENERATION BROADBAND WIRELESS PAN TECHNOLOGY ON UWB(ULTRA WIDEBAND) AS A PROMISING TECHNOLOGY

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1. Introduction

As digital devices like notebook PC, mobile phone, PDA, digital camera, etc have been become ordinal products and increased around an individual environment. Requirement to develop communication method between these digital devices is getting strong. By responding to this demand, Bluetooth™ industry group formed by original promoters ; Ericsson, IBM, Intel, Nokia, Toshiba in May/1998. They started to create common specification and finalized specification revision 1.0 in July/1999. On the other hand, IEEE started PAN (Personal Area Network) discussion separated from Wireless LAN group : IEEE802.11, then IEEE802.15 WG(Working Group) was formed to define PAN standard in 1999. As a first standard, IEEE802.15 WG adopted Bluetooth™ SIG's proposal in 1999. The first standard offered 1Mbps physical layer that was considered sufficient to cover link between mobile phone (even with 3G cellular phone) and notebook PC and to deliver text information. While processor's performance of PC and other digital devices has been dramatically improved, quantity of data to be transferred each other has also significantly increased. As a result, requirement for Wireless Broadband communication is getting strong. IEEE 802.15 WG formed dedicated study group: SGa to define higher rate PHY in Nov./2002

2. Industry's expectation to broadband Wireless PAN

Next generation of Wireless PAN requires higher bandwidth. Multimedia data like video stream will be delivered on the wireless pipe. At the era, each segment shown in Fig.1 must be

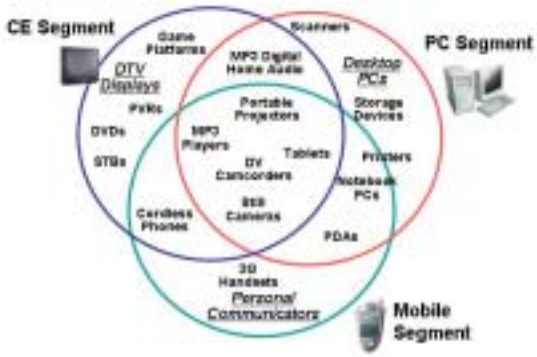

Fig. 1 Wireless PAN Application area

connected seamlessly for end-user's convenience. In this sense, one unified PHY is truly expected for operating on various CE (Consumer Electronics), PC and mobile devices. Also, ease of install and use must be considered.

It is said that the market of broadband wireless PAN will start from 2005 and the total market size is estimated over 100 Million devices at 2009. Though resolving world-wide regulatory issue is an assumption, tremendous wireless broadband market is coming.

3. Technical requirement to next generation of wireless PAN

In July 2002, IEEE 802.15.3 SGa showed some criteria to meet all of application as below.

- Co-exist with IEEE802 wireless PHY
- Bit-rate : >110Mbps @ 10m, >200Mbps @ 4m, >480Mbps capability/scalability
- Robustness to Multi-path
- Positioning capability
- Cost and BOM(Bill Of Material) similar to Bluetooth™

To meet above requirements, several companies prepare to propose technology based on UWB(Ultra WideBand) technology in IEEE802.15.3 SGa. Selection of next generation wireless PAN's PHY will start from early 2003.

4. UWB technology

UWB (Ultra WideBand) technology has very long history and origins from "Spark Gap" communication. Basically, this utilizes extremely short period of pulse signal e.g. less than 1nsec. Thus the spectrum spreads extremely wide frequency range.

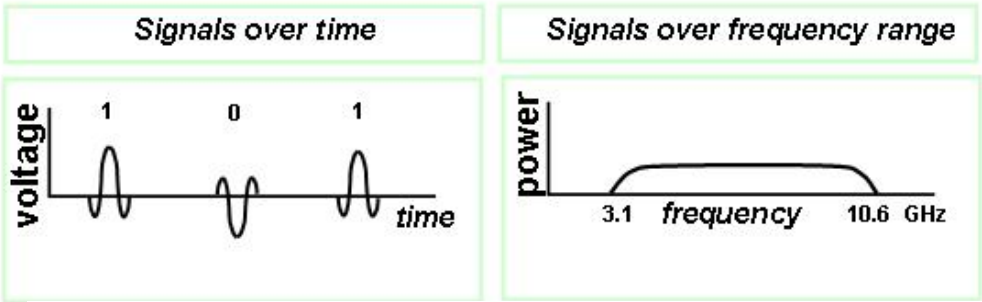

Fig. 2 UWB technology Overview

Basically, UWB radio does not require RF circuit which produces continuous carrier signal, just transmits "modulated pulse" signal directly. This characteristic has potential property to offer low cost and low power consumption of the wireless communication system. And this also has good aspect which is favorable to existing CMOS semiconductor process. Using extremely short width pulse that is generally less than 1 nsec brings strong robustness to multi-pass interference. For example, assuming 10-20nsec delay spread in

10m square room, it is not tough work to distinguish several paths. By measuring time traveling from a certain object, we can calculate the object's position. Thus, UWB has superb characteristics by nature. Not only PC industry but CE industry has strong interest to enable this technology.

However, there are several technical challenges to be overcome to utilize it.

- Receiver complexity for pulse Synchronization
- Inter-symbol interference for higher data rates
- Multiple access : sharing "single channel"
- Wideband antenna

Intel is proposing "Sub-banded architecture" for multiple access and avoiding specific interference as shown in Fig.3.

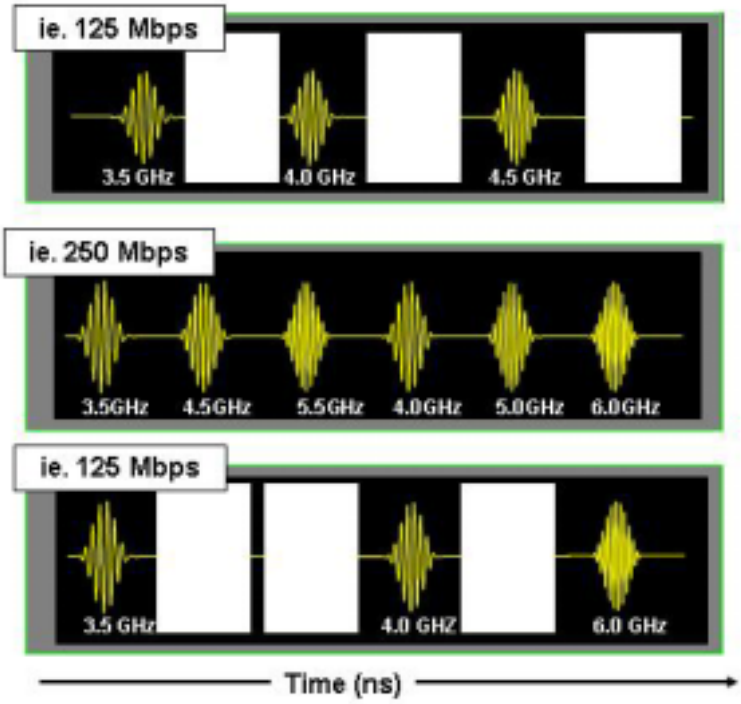

Fig. 3 Sub-banded architecture

This methodology offers flexible utilization of given bandwidth. And this can adoptively avoid certain interference on specific frequency. This flexibility would be required to make global regulations.

In addition to technical matters, we need to resolve regulatory issue for world-wide use. As of today, the US FCC opens 3.1-10.6GHz for UWB short range communication with transmission power limitation of -41dBm/MHz. Rest of the world country does not allow this radio.

Further more, antenna would be a big issue. The reason why is that the antenna has to cover huge frequency width on not only receiving but transmitting. Considering usage scenario utilized by small mobile device, form factor must be much smaller than existing

technology such as discone antenna.

5. Summary

UWB technology has good potential capability for future wireless broadband PAN. The author believes it's a promising technology. However, for realizing product utilized UWB technology in worldwide, we have several technical and regulatory issues to overcome. The author expects academia and industry to develop new epoch-making technology by jointly working with and to co-operate to resolve regulatory issue in world-wide.