

Reminiscing The Wibree Technology: An Achievement In Contemporary Research On Wireless Telecommunications

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Abstract—When mobile phone technology giant Nokia announced the development of Wibree, the wireless radio technology, many analysts, competitors, and experts responded with mixed reactions. However, like other inventions brought into being for the advancement of human life, the introduction of the Wibree has contributed a lot in various ways and to the betterment of our lives and living conditions. This study submits a review of the literature on the Wibree technology from multiple perspectives. It argues that filling a technological gap had led Nokia to invent the technology while some of the negative comments made upon the early announcement of the creation of the Wibree technology were prompted partly by insufficient information in the side of the critics

Keywords—Baidoa, Hakaba, telecommunications, wireless sensors, wireless technology

I. INTRODUCTION

Ever since man came on earth, exploration and discoveries have become a way of his life. This is to appreciate that with man's effort to improve his environment and his way of living came what we may call technology. At that time in the far past, though we may call it names such as "primitive culture," "primitive people," "pre-civilization era," man developed skills to control his environment by learning how to live better and cope with his daily trends, according to his available technology, even if somewhat not advanced as today. From this "primitive" beginning, we want to argue, started the various advancements in the technology we enjoy today which gave us a lot of opportunity to exploit our earth and environment.

In our present world, information technology is one of the most celebrated technological achievements of man, if not the most celebrated field. Because of this accomplishment, IT is worshipped as the major success of the century. As we see and use it today, IT has led man to overcome the global communication barrier. Because of this technology, the world has become a network of "a global village" connected to one another where the use of the internet and the mobile handset play the most significant roles. With all this advancement, man is yet in a continuous attempt to explore and discover more avenues to expand his exploitation of technology in order to overcome the challenges within the unexplored sectors of phenomenon technology.

In recent years, the area most affected by IT has been in the internet by using computers and mobile phones. Through these devices, and others used elsewhere in different industries and professions, communication and connectivity are considered as a normal way of life where an aged grandmother in a remote African or Asian village can communicate with her grandchild in a modern cosmopolitan city anywhere in the world. Therefore, in order to appreciate the continuous achievement in technology, particularly in the IT sector, this essay presents a discussion aimed at reminiscing about the Wibree and its role in contributing to the revolutionization of wireless communication. In the next section we review the related literature, followed by the method of study and the analysis and discussion in that sequence, before coming to the conclusion.

II. REVIEW OF RELATED LITERATURE

Technology and Taxonomy of Wibree

Every product in our world has an identity which makes it distinct from other products of the same type or others far different from it. Product identity, therefore, has brand importance and patent which is unique to the bearer just like human beings have individual names and properties which are part of their personal, cultural and social identity. In the same way, the patent nomenclature "Wibree" is the name of the device under discussion in this essay. It is the brainchild of Nokia. The word "Wibree" has been formed from an intermarriage of two words. The first part, or the prefix, was derived from the famous word "wireless" which implies communication and/or connectivity without employing the traditional mode of cable as the link between two or more apparatuses used during communication. In modern day technology, the 'radio' is the most popular example of 'wireless' communication through which diverse messages are disseminated across nations and continents and to a large number of customers/audience.

The second part of the word, which we may call the "root" or the "complement" which is "Bree," has originated from an old English word that has the same meaning as "crossroads", which basically means intersecting routes. The descriptive word 'crossroads' has itself been derived etymologically from the old Irish 'cros' or possibly from the Latin 'crux,' which might have as well been a loan word of Phoenician origin. The second part of the word "crossroad" hence 'road,' is an old English etymology that "comes from the same ultimate source as ride" (Ayato 2001; EE Times 2006). The intermarriage of these linguistically remote words has resulted Nokia, the creator of the device in our concern, to make it an identity or patent name for the product. Later, as the development of the technology progressed, it was given a name which was then known as Ultra Low Power (ULP) Bluetooth, (Chavda et al. 2012; Alun Williams 2007). It was designed "to connect a wide range of computing and telecommunications devices easily and simply without the need for connecting cables" (Chavda et al. 2012:400).

The selection of a product name is strategic as it serves important goals of the producer or owner. Bearing that strategy in mind, every name is meant to deliver a clear message of the bearer to be identified with the name and all that appertains to the device. Therefore, the message the word 'Wibree' was set to deliver was an expanded and extensive wireless connectivity across a mesh of crisscrossing interrelated communication apparatuses, loaded with its potential of filtering through a mass of voice as well as graphic data. With the introduction of this gadget, consumers experienced a further advancement of the way to manipulate, exploit and experience information and communication technology in their daily life. It further added to the simplification of the way people handle data in more appropriate ways than the experience was prior to the use of this small but useful technology.

Features and Functions

The initial concept to produce a component like the Wibree is attributed to Nokia researchers engaged in the company's research and development (R&D) segment. Their aim was to bridge or narrow a gap which a variety of wireless technologies have overlooked addressing. According to Williams (2007) and Chavda et al. (2012), the development of Wibree has taken root in the year 2001 although the announcement came much later. As many observers and analysts would agree, research experts at the Nokia Research Centre embarked on the development of this wireless technology by drawing from an existing technology which was seen to be appropriate for the delivery of Nokia's final product (The Future of Things: www.thefutureofthings.com). The existing device was the Bluetooth, which was designed to enhance the function or usability of the mobile phone and a wide range of other technologies that needed the use of low power consuming radio that could be operated within a limited distance to facilitate wireless personal area network (WPAN).

Being well aware of the technology and the market, Nokia's aim was not in fact to produce another version of Bluetooth but a different device that had the standard of a Bluetooth but with lower usage of power and "as an addition to the Bluetooth family of specifications, enabling a new class of devices that Bluetooth isn't really suitable for today" (Michael Foley cited in John Blau 2007). When the new technology was announced some time in 2004, Nokia named the new equipment as Bluetooth Low End Extension (Honkanen, Lappetelainen and Kivekas 2004). It was only after the device had undergone further enhancement with other partners that Nokia renamed the product 'Wibree' and as an essential technology with a difference. The birth of the brand name Wibree came in 2006 as a result of the development of what was initially termed as Bluetooth Low End Extension.

Later in 2007, Nokia reformulated its strategy. The outcome of this reformulation of strategy has necessitated the formation of an alliance with the manufacturers and owners of Bluetooth. Michael Foley of Bluetooth Company confirmed the merger: “Our members have been asking for an ultra low power Bluetooth solution. With Nokia’s innovative development and contribution to the Bluetooth specification with Wibree, we will be able to deliver this in approximately one year” (Michael Foley quoted in Blau 2007). Peter Svensson (2007) also wrote in an article that Nokia “formed a Wibree Forum with other companies to license and exploit the technology, an effort that will be subsumed by the Bluetooth Special Interest Group which includes about 8.000 companies.” Consequently, an agreement was made that would allow future Bluetooth specifications to include Wibree as an inbuilt ultra-low-power technology. According to Svensson (2007):

Devices with Wibree chips will not be able to communicate with existing Bluetooth-equipped devices... However, future Bluetooth devices could relatively easily and cheaply be upgraded to include the talk to Wibree devices, since the technologies use the same frequencies and no new antenna or radio components would be needed, (Svensson 2007).

Although Wibree technology shares some similarities with Bluetooth as a wireless radio technology, Nokia, the famous mobile phone maker, informs the industry and the consumers that Wibree operates at a much lower power consumption level than Bluetooth. By this focus, function and tradition, Wibree might have been established as a technological initiative with an open industry business dimension. Like its preceding wireless mechanisms, Wibree also aspired to be a well recognized brand name in market, a recognition that was achieved through the application potential of the product. For example, the recent history of wireless technology informs us how Wifi succeeded in gaining mass market application by using laptops, a strategy that helped it to sustain and enhance connectivity. In a similar manner, Bluetooth has made use of the mobile phones and other Bluetooth enabled devices while Wibree has been accommodated in Bluetooth itself.

Single-mode and Dual-mode Chips

Wibree, according to its technical specifications, has taken two strands to maintain sustainability through connectivity. On the one hand, it boasted of a feature that functioned with dual-mode chips in order to be able to support the dual or multiple applications of both Bluetooth and Wibree. The strategy was for the Wibree to function as an in-built device operating inside and alongside Bluetooth. The existence of this close relationship between Bluetooth-Wibree devices was considerably significant for the success Nokia had anticipated the Wibree technology would achieve in the market.

On the other hand, Wibree was also designed to have a single mode chip with low power operation. The single mode chips work as stand-alone solutions that can enable a large variety of appliances to communicate with their counterparts, the dual-mode chips. Because of these specifications, and Nokia’s forethought of the Wibree as another potential competitor in the 2.4 GHz range, many in the industry as well as experts and analysts initially described Wibree as a new wireless technology that was seeking the destruction and disenfranchisement of Bluetooth and other same category technologies. The dubbing 'Bluetooth-killer' was coined to refer to the Wibree although the suspicion was diffused upon the strategic alliance made between the Bluetooth SIG and the Wibree Forum.

A very significant component or application of the Wibree is that it encompasses a large variety of mobile phones, enabling the handsets to become a through-way for data by using an internet-based monitoring device. By intervening in this area with such an incredible strategy, Wibree has developed itself into a market where applications related to consumer monitoring were not yet fully exploited, thereby filling an important gap. For instance, when compared to products such as the GPRS, which requires a considerable amount of expenditure in terms of unavoidable hardware costs, the Wibree technology was a much cheaper device to afford:

consuming only a fraction of the power compared to other such radio technologies, enabling smaller and less costly implementations and being easy to integrate with Bluetooth solutions to connect a wide range of computing and telecommunications devices easily and simply without the need for connecting cables, (Radhika, Ramya, and Karthik 2013:199).

In addition, the Wibree technology was designed to allow “more complex star-bus networks to route information around multiple piconets (ad hoc network of one master and seven slaves,)” (Agarwal & Sharma 2017:3). Power consumption and energy conservation are aspects so vital to any new wireless technology to survive in the consumer market of a growing competition in the area of information technology. The target devices that the Wibree uses for its application include wrist watches, wireless

keyboards, toys and sports sensors as well as other high tech gadgets which require very low power consumption (<http://thefutureofthings.com>).

These applications are very important for the reason that Wibree would at least not be seen as a competitor all out to disenfranchise Bluetooth by stifling its market-hold. On the contrary, Wibree was best operated as a complement of the Bluetooth technology since Wibree enabled instruments would constitute properties much smaller and more energy-saving than the Bluetooth would provide (Gratton 2013). Therefore, the less consumption of energy is what makes Wibree more suitable to operate from within Bluetooth devices. Confirming the power efficiency of the Wibree wireless technology, Bob Iannucci, head of the Nokia Research Center at the time, revealed that the Wibree technology was developed with power efficiency ten times more efficient than the Bluetooth.

Apart from ultra-low power, what made the Wibree more attractive and economically more consumer-oriented, is its installation in the Bluetooth as part and parcel of the properties made up of the Bluetooth. That is mainly the reason why the Wibree Forum considered a merger with the Bluetooth Special Interest Group (SIG) (Shruthi et al. 2014; Minoli 2013). The collaboration between the two technological partners then saw the efficiency of the Wibree technology when connected to very small button-cell battery-powered items like watches or even sensors that might be fixed to the body of a user. This kind of strategic market penetration did not only contribute to the popularity and tactical advantage of the Wibree, but it also realized an unequalled rapidity in reaching the consumer as well as presence in the bulk of handsets loaded with the wonderful magic of the Wibree. Despite the records set or broken by existing wireless technologies in reaching peak sales in the market, certain wireless radio connectivity issues now remain a conundrum of the past due to the arrival of the Wibree technology into the consumer market as carried in the belly of the Bluetooth.

As we have learned from the merger between Nokia and the Bluetooth SIG, the magic formula to market the Wibree was the timely decision of its adoption by and adaptation to the Bluetooth. From a mobile handset equipped with Bluetooth with its inbuilt Wibree device, everyone with such a handset is automatically entitled to communicate through the internet with an unlimited information exchange forwards as well as backwards. Compounded with this advantage is the cost effectiveness of the transfer of data to and from its access handset, which is estimated as a merely insignificant amount which may not be heavy on the consumer's pocket in purchase or in use more than the initially stipulated monthly or annual fee of the contract, thus varying from country to country or from one provider to the other.

At that early time of the maiden technology, not much was known about the Wibree. But the little information available from its website was adequate to provide, at minimum, a hint of what the consumer could expect from it. Functionality of Wibree and its durability indeed depended on the quality of low power consumption and wireless data transmission it was promising to the customer. Of course the manufacturers knew only too well that application is usually the basis for determining low power, at least in certain circumstances. The concept informs that the longer a gadget stays in use, and the more data it submits, obviously make the durability and efficiency of the battery very short. In such a situation where the longevity of power is short, the consumer cannot appreciate a wide and undisrupted access due to the power distress. For that reason, operability becomes somehow limited and with inconveniences. In order to address this negative aspect, Nokia researchers on the development of the Wibree were able to produce a wireless radio technology with a capability to transmit a mass of data in seconds, and with an estimated life of 12 months or so, without a hitch or malfunction of the battery. Another advantage of the Wibree lies in the durability of its battery, a tiny button cell, and the like of CR2430, with potential of about 280 mAH (John Blau 2007).

According to the producers, Nokia, the device was developed to function like a smart radio designed with a protocol that enables it to lay asleep for quite a considerable part of its lifetime. The smart radio can then wake up to life as it receives a piece of information to disseminate and rapidly transmit it to as many channels as it needs to contact within the stipulated range. The assumption at the time was that, for the connectivity and operability of networking, it was necessary to design receiving equipment which would possibly utilize a large capacity battery with potential and power to stay on for most of the time. Such a device was set to be the one that would first receive the message for acknowledgement, before it could direct the first device to the right channel when it should send the message onto. After transmission to the right channel has been executed, both devices would then go back again to sleep. The most interesting phenomenon here remains to be the execution time which is as short as less than half of a second.

However, the production and success of the Wibree technology did not depend only on the design and function but also on its cost efficiency from the perspective of both the manufacturer and the user/consumer; in other words to all the parties that are stakeholders. In this regard, Wibree enjoyed a unique advantage by being installed within the set of the Bluetooth chip as built-in mode, another unique advancement in wireless radio communication technology. This way, the intermarried devices would operate with minimum expense to the consumers who are the final users of the product.

III. METHOD OF STUDY

The method used by this study is in the qualitative domain and mainly based on review and analysis of secondary data collected from various web-based, expert and academic sources. It looks closely at the existing literature on the topic of our discussion, the Wibree technology introduced by Finland-based communication giant Nokia. This means of data collection has been necessitated by the fact that there are multiple benefits of the technology today; yet there is still paucity in recent literature concerning this technology when considered the breadth of its use.

Because the technology itself is subsumed into another older, popular, well marketed, and abundantly utilized technology, the study limits its scope to a review of the available literature as well as discussion and analysis of these variant literatures. The strategy is supported by scholars and educationists who discussed the importance which underlies invoking available literature. According to Best and Kahn (2004:39), "Citing studies that show substantial agreement and those that seem to present conflicting conclusions helps to sharpen and define understanding of existing knowledge..." of the matter under appraisal. The underpinning factor, in their perception, is that "Capitalizing on the reviews of expert researchers can be fruitful in providing helpful ideas and suggestions" (Ibid.).

Although we coincide with Best and Kahn, it is also relevant to invoke the more recent thought by the critical analyst and educator Ali Jimale Ahmed (2020:11) in selecting only what the scholar would portray as the "exemplary nuggets of knowledge." By that, the educationist Ahmed means "[the] kind of pedagogic knowledge that derives meaning from a precedent, a past still capable of framing the future,"—which according to Dooley (2004:285) would constitute "...only the most valid studies [which] deserve our attention." Invoking these scholars' reflections, the current study conducts a review and analysis of the criticisms toward the Wibree technology and then moves on to the conclusion section. The reason for considering the 'Criticism' section is to present "conflicting" (Best & Kahn, Ibid) versions from which we can establish "exemplary nuggets of knowledge" (Ahmed, Ibid). The strategy to do so is prompted by the quest to control our human tendencies to bias (Baron and Byrne 2003:143) and avoid "...jumping to a false conclusion" (Baron 2003:620).

IV. ANALYSIS AND DISCUSSION

The Critical Views

So far, it is not a secret that Nokia has conducted tests on the prototypes it has produced as parts of the Wibree technology before completing and marketing the full standard of the device. Despite the try-out, there were criticisms from certain circles. Bill Ray, one of the most stern critical analysts, blasts the Wibree as a standard "pretty poor in comparison to some other short range wireless technologies on the market, such as Zigbee and Z-Wave, both of which are established with hardware in production," (Bill Ray, 2006). Ray's comment further goes to suggest that none of the two mentioned wireless technologies is threatened by the Wibree's venture and attempt to penetrate the market. Ray (2006) puts on record the Zigbee alliance's boastful remark as saying: "We can only surmise that this is simply a proprietary solution masked as some type of industry driven push." In a similar notion, an official from the owners of Z-Wave, Zensys, disdains the ULP Wibree by stating, "It seems like a marketing spec, they have said nothing which would worry me," as quoted in Ray (2006). In the same line of analysis, Mitchell (2006) describes the Wibree as a device "too limited to compete with WiFi..."

Airing the prevalent information gap over the Wibree's "different focus" from those of Zigbee and Z-Wave, and somehow concealing his frustration at the lack of sufficient explication on the product by Nokia, Bill Ray admits: "Quite what that focus is isn't clear." Interestingly, while the critic Ray is acknowledging paucity of information to base his judgments on, he nevertheless embarks on the path of a biased analysis in his argument; rather opting the implausible measure of making decisions in the very absence of the detail which he affirms—thus becoming "victim of the rhetoric he sets out to analyze," as Ahmed said elsewhere (Ahmed 1996). He even critiques, in the very midst of lack of detail, saying, "Nokia keeps citing the connected watches and shoes, as well as keyboards and mice, as its target market," again casting aspersions over the manufacturer's intent and strategy. It is indeed from this frustrating atmosphere of lack of acquiring credible information that Ray extends his biased

speculation that, to quote him verbatim, "...it seems unlikely that those constitute enough of a business to justify their own wireless standard." The criticism takes another turn by suggesting as unnecessary Nokia's initiative when actually Bluetooth was doing well with a similar purpose. In his short article, Ray continues his accusation and judgment saying: "Squeezing their market down to watches and shoes surely makes it insignificant, and ironic, as sales of watches are dropping because people use their phones to tell the time." The irony in the unenthusiastic intonation of the pessimistic critique is carried on: "So we are left with a half-finished standard, addressing a tiny market which might not even exist, and why Nokia chose to announce it now."

In our opinion, neither Nokia nor the other partners, or any other business entity for that matter, would propose an alliance or a merger before putting in place (and based on results of research and development) the necessary potential, aims, objectives and goals of the new technology they intend to supply in a competitive market, unless they do not regard much for their reputation. That said; Ray's negative diatribe could be attributed to lack of detailed information about the product in question, as he also suggested. This lack of detail about the Wibree technology might have haunted the market intelligence as to determine exactly where Nokia was actually heading with a product that would have to survive 'parasitic' life on another product already established in the market. The ensuing frustration from the inadequacy of information from Nokia could be surmised from Ray's concluding remarks of self-consolation that "Surely it would have been better to wait until the standard was completed, at least in draft form."

Ray's suggestion is clear that Nokia had not at that time provided about the technology sufficient information to enable others make conclusions about the actual benefits of the end product. Hence, the criticism caused by speculations of what Wibree would look like considering that the "announcement of the Wibree standard by Nokia [seemed at the time] to have caught the industry unawares," (Chavda et al. 2012:401). The commentators have not in their comments committed much of logical critical analysis onto the subject, hence contemplating too little about the fact that "no one wireless technology is the universal panacea—each [having] its specific niche within the brave new wireless world [while] [m]ost have specific areas of excellence and many overlap" (Ibid, p. 400).

We believe that criticism, when constructively conducted, bears fruits which people appreciate because it reveals a different opinion, an opinion that would remain unknown had it not been brought forward by the other discussant. From this narrative, we need to approach matters with an open mind, despite us, as humans, being subject to bias. But in the concern of Wibree, the criticisms might have been unleashed according to the point of view of the critics. As we mentioned above, the provocation might have been triggered by insufficient specifications about the new product, as we furnish here a supporting example from Nick Hunn (2016):

Following an unexpected launch, Wibree has been subjected to an initial flurry of misunderstanding and then has been largely ignored. The reality is that it is poised to become the fastest growing wireless standard ever. Its symbiotic relationship with Bluetooth will open up massive opportunities for network operators to deploy new consumer based services, kick-starting the C2M Consumer to Machine market.

This observation, though optimistic in nature, begins with clear manifestation of the unwelcoming manner in which Wibree was initially received. But in order to diffuse the doubt filled in the atmosphere, critics as well as general consumers should have waited until Nokia provided the specific details the market and other technology analysts would require. Alternatively, they could wait patiently till the manufacturer made the product available in the consumer market so that the true nature of the functions of the Wibree technology could be determined according to its efficiency as well as market response.

However, notwithstanding the criticism, Wibree did not claim to be either the only or even among the highest income portfolios of the company as Nokia generates more revenue from several other telecom related technologies and services. According to Forbes (2019), the telecom giant Nokia makes huge earnings from networks and licensing of its products as it "primarily sells its hardware to wireless carriers," and at the same time "licenses its patents to handset and chipset vendors" (<https://www.forbes.com>). Despite an estimated loss of "around €1 billion to its revenues over the last two years, largely due to decline in the Networks segments," expectations remained high for increase of revenues in the next couple of years i.e. 2020-2022, according to Forbes (2019). Forbes details the prospect as follows:

Overall, Networks revenues declined from €23 billion in 2016 to €21.1 billion in 2018, driven by weakness in the mobile and fixed access space partially offset by growth in IP routing. We expect revenue to grow slightly in the next two years, to about \$21.3 billion in 2020, driven by the adoption of 5G technology. Nokia has 50 commercial 5G wins as of

November 2019 and it's likely that this will be the biggest growth driver. Networks sales contributed 93% of total revenue in 2018. It is expected to remain at similar levels by 2020.

Security Considerations

The design, production and marketing of a new technology may not bear good results, particularly in the field of information and communication technology, if issues on privacy and security have not been very carefully thought of. In fact, security is a very sensitive area that requires confidentiality in preserving the privacy of the consumers by keeping their data, whether written, oral/aural or visual, securely stored. Code-breaking, hacking, and virus threat have haunted many a user of an IT technology or device, making him/her so vulnerable and unprotected from intruders who deliberately break the security code of conduct and related protocols and batches.

Security needs to be considered more important now than ever, particularly considering what is currently happening to large corporations in the US and Europe, where unruly Russian hackers are accused of causing havoc, asking for huge amounts of ransom money for releasing confidential data they have stolen. As a report by the Congressional Research Service (CRS 2021) confirms, "Russia's security agencies compete with each other and often conduct similar operations on the same targets, making specific attribution and motivation assessments difficult." Russia, according to the Congressional report, has deployed professionally trained hackers affiliated to different units which operate under the guidance of its military intelligence and security organs. These and other entities are the agencies designated to hamper the electoral campaigns and processes of the USA in 2016 (CRS 2021).

Once the security system is impenetrable it builds high morale and confidence that strengthens the bond of trust, reliability, and loyalty between the producer and the consumer. As Ekberg (2007) encourages us in the case of the Wibree, "A concern that specifically has been addressed by the security design is address privacy." According to Ekberg, the technology gives more assurance in the sense that "The embedded privacy solution in Wibree goes a long way towards eliminating the mobile tracking threat in many practical scenarios." However, this does not warrant that technologies will not be invented and developed that will not possess the capability to track the location of a user and steal or confiscate data.

While not militating against Ekberg's view, this will also take a long way to convince the consumer in light of the fact that several reputable researchers and research institutions reported flaws on other technologies on various occasions and in different locations. One source that recounts these events of flaws and security accessibility is Wikipedia, the web-based encyclopedia. Some of these events, as retrieved from the web site <http://www.exampleproblems.com/wiki/index.php/Bluetooth>, are reported as below:

In November 2003, Ben and Adam Laurie from A.L. Digital Ltd. discovered that serious flaws in Bluetooth security may lead to disclosure of personal data. It should be noted, however, that the reported security problems concerned some poor implementations of Bluetooth, rather than the protocol itself. In a subsequent experiment, Martin Herfurt from the trinite.group was able to do a field-trial at the CeBIT fairgrounds, showing the importance of the problem to the world. A new attack called BlueBug was used for this experiment. In August 2004, a world-record-setting experiment (see also Bluetooth sniping) showed that the range of Class 2 Bluetooth radios could be extended to 1.7 km (1.08 mile) with directional antennas and signal amplifiers. This poses a potential security threat because it enables attackers to access vulnerable Bluetooth devices from a distance beyond expectation.

The perceived advantage for Wibree was that it would not experience interference in the deployment of wireless radio where the 2.4GHz band might experience a certain level of interference. Because Bluetooth has overcome such a problem as an application resistant to interference, Wibree has sought a perfect solution to the requirement of the ultra low power function, a conundrum which was haunting many wireless radio producers. How did Wibree overcome this challenge? According to a report on the web site (www.123seminaronly.com):

Because the conversation between devices allows the responding device to select the radio channel to use, it introduces the concept of frequency agility, where the two radios can move to undisturbed parts of the spectrum for their data transmission. In most cases, this receiving device will be a mobile phone, which is acting as a gateway. The same Bluetooth chip that contains the Wibree radio within the phone will be constantly scanning the radio spectrum as part of

its adaptive frequency hopping requirements to see what spectrum is free. It makes perfect sense to share this information with Wibree radio to give it the frequency agility that it needs to meet high reliability applications.

A close examination of the above information shows the fact that existing inside the set up of the Bluetooth chip provided significant advantages to the Wibree as a component or device. First, it has interplay with the Bluetooth while at the same time executing its designated functions. Second, it does so without interfering in its messaging as well as other networking systems. Third, this mode of functionality and operability of the device gave the Wibree an edge over the other technological systems that were/are in the ICT market in the sense that it proved itself a step ahead strategically, technologically as well as commercially.

Strategically, the Wibree Forum from the Nokia stake holding consortium has succeeded in implementing a merger with the Bluetooth SIG (Special Interest Group) representing the stakeholders of Bluetooth technology. The other reason why the strategy became successful could be related to the reality that better technological advancement was realized particularly when two successful technological gurus have been interlocked in a merger of this nature which targeted to reach billions of customers who are eager to exploit every possible technology usable to their advantage.

Prospects

The success of a product partly depends on its penetration potential into a market. Subsequently, its endurance in the market is determined by the level of its user satisfaction, which is related to its function and the advantage/s it can provide to the consumer compared to competitive products in the market. With these factors in mind, one of the technological advancements favoring the functionality of the Wibree is the integration within the Bluetooth chips. Given that Wibree kept living up to the expected standards or may be better, no doubt that the skeptics realized how the technology gave a redefinition of Nokia's reputation as a developer. Within a short time, an extensive number of Bluetooth chips were adapted to the functionality of the Wibree to enhance interoperability, almost without incurring expenditure to the consumer. To extend the foot-hold of the new technology in the market, nearly 100 million handsets equipped with Wibree technology were made available for operation and use by 2009 (Radhika et al 2013).

Commercially, the merger or alliance, from business perspective, should be rewarding as the foresight to that prosperity is indicative from the background of the concerned entities as well as the devices espoused. Commercialization consists of a host of interrelated factors including demand, production, marketability of products, and affordability of prices as well as profitability rate of the product to the producer. Therefore for any company, the sustainability of its products in the market determines the profit margin of the products it markets. Davis et al (1992: 494) make a clear comment on the importance of profits and profitability: "Profits are essential for any business. Unless there is a sufficient profit margin, the business cannot exist. The jobs it provides, the products and services it delivers and the contributions it makes to the community would cease." In view of the importance laden to profitability, the two partners of Wibree Forum and Bluetooth SIG had surveyed options and avenues for their profitability before entering the accord of alliance. Both must have been attracted to the prospective profits each of them could garner before virtually honoring the initial proposal leading to the venture.

To achieve its ultimate goal, Nokia cooperates technologically and commercially with Bluetooth giants such as Cambridge Silicon Radio and Broadcom as well as many other partners. Together, the parties are fulfilling the strategic intentions and market expectations by providing technologies that offer better connectivity for cheaper rates, a good value for money in the part of the end-user. In more practical terms, Wibree, as a member of the wireless sensor technologies (WSTs), is contributing a lot—not only in the mobile network technology but indeed in as many fields as possible including in the management of agriculture and in animal and water monitoring where wireless sensor networks (WSNs) are employed for the benefit of the biosystem (Martos et al. 2021; Njuu 2019; Neethirajan 2017; Abbasi et al. 2014).

To conclude this segment, there are two factors to bear in mind. The first one is the evolution that came with Bluetooth and Wibree as two intermarried technologies that operate as one. That development has resulted in the disappearance of further discussions about Wibree as an independent entity for the reason being "Wibree [had been] acquired by the Bluetooth SIG and evolved into the hallmark feature of Bluetooth v4.0," (CNBC, 2012). However, whatever technological enhancements made on or profits and benefits made from Wibree are featured as a component within the mother gadget Bluetooth as the latter is the flag-bearing name. From this scenario comes the second factor which is the extensive expansion of Bluetooth into the four corners of the world and growing.

According to McCaskill (2021), “Annual shipments of Bluetooth-enabled devices are set to top six billion by 2025, according to the technology’s industry body.” Although the “six billion” figure marks a significant commercial achievement, one should take note of the current reality of international business and economic hardships that hit the world. Yet, Bluetooth forecasts its projected 2025 target figures despite the setback that “Shipments remained flat at four billion during 2020 as the technology industry faced challenging conditions caused by the economic and social impacts of corona virus-related lockdowns and social distancing measures.”

Although the COVID-19 pandemic created sales and distribution fallbacks, it might have been a blessing in disguise for the company as:

...some categories received a boost from changing consumption habits. The shift to remote working saw a spike in demand for PC accessories, while a focus on health and fitness saw wearable shipments increase. Other long-term growth areas include connected lighting systems and connected health applications, as well as Low Energy audio devices that can also help people with hearing loss, (Ibid).

V. CONCLUSION

The area of Information Technology is expanding fast, and with multiple challenges in various spheres. The development and advancement of the internet and the use of the cell phone have also increased the challenges pertinent to this field of study. Yet the intermarriage between the internet and wireless devices is contributing to the challenges man has to overcome as a good manager of his environment and the very technology he created to benefit him. But in order for man to manage the environment in a desirable manner, inventions in IT such as the Bluetooth and the Ultra Low Power (ULP) Wibree and others in use should be seen as a step forward toward a good end.

On the other hand, managing one’s environment may not achieve good results if consumers who are part of that setting do not have much confidence in the protection of their privacy and security of the sensitive data and information that is not meant for illegal intruders who utilize that information to commit crime, advance defamation of others, or even cause industrial damage. Bluetooth and Wibree may celebrate a technological achievement and probably a high gain of profit in the market, but efficiency in the security system and safeguarding the privacy of the consumer may determine whether or not any new or existing technology can stand the test of time.

By raising the point about security and privacy, we mean to highlight the importance in the advancement of the knowledge of security, particularly in information and communication technology. Professional higher training which a large number of students worldwide are undergoing in advanced postgraduate studies interprets the need for experts to handle the growing challenges in the issue of security. We have to keep in mind though, that others who are equally brilliant, knowledgeable and professionally well trained are engaged in violating the security protocols and cracking passwords, albeit illegally. While we raise this concern, we are also aware of the recentness of advanced studies in IT security systems. Despite that, a considerable number of consumers are banking their IT security trust in the area experts who are expected to live up to the expectations by safeguarding consumer privacy and integrity.

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