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Rezence – Wireless Charging Standard based on Magnetic Resonance

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Abstract: With the advancement in Wireless Technology, Wireless Power Transfer (WPT) is one aspect of the field which has garnered immense recognition over the past couple of years. Different Wireless Charging Standards are based on different principles, namely Magnetic Induction and Magnetic Resonance. Rezence is an interface standard developed by the Alliance for Wireless Power (A4WP) which is based on the principle of Magnetic Resonance. Rezence purports itself to be the "next-generation" of wireless charging technology. Rezence systems are loosely-Coupled (LC) WPT systems. This enables Rezence systems to charge multiple devices of diverse sizes and power requirements. Owing to this, LC WPT systems are finding a way into the day-to-day mainstream application of charging portable consumer electronic devices. Thus, by means of this paper, I endeavour to illustrate the working of Rezence and its advantages over other WPT systems.

Keywords: Wireless charging, Rezence, A4WP, Wireless Power Transfer, Magnetic Resonance.

I. INTRODUCTION

Wireless Power Transfer (WPT) systems are extensively used in this day and age to power various portable electronic devices such as smart phones, laptops, Bluetooth headsets, etc. While, the advancement in smart phones and other wireless devices has been tremendous, they are highly dependent on batteries for their operation, which as it turns out happens to be their biggest weakness. Battery technology hasn't advanced much in the past few years and it has failed to keep up with the exceedingly dynamic consumer electronic (CE) industry. People have to charge their devices frequently to use them continuously. Different devices are charged using different cables and have variable power requirements. This is where the concept of WPT proves to be useful. WPT is a process that occurs in any system where electrical energy is transmitted from a power source to a load, without the connection of electrical conductors.

Fig.1Multiple devices being charged by Rezence at the same time

Rezence is a WPT technology and specification that is based on the principles of magnetic resonance. Traditional WPT systems rely on tight coupling of the transmitter and receiver coils to maintain the required power efficiency. On the other hand, Rezence relies on loosely-coupled (LC) WPT systems to charge the devices. Rezence is based on the concept of spatial freedom, which enables it to supply power to devices over a larger area than the traditional systems [1]. LC WPT maintains efficient power transfer with relatively far separation distances (tens of millimetres) even with coil coupling factor less than 0.1. In addition to convenience for consumers, LC WPT gives industrial designers greater flexibility in embedding WPT capability into work surfaces, home furniture, and automotive environments, as shown in Fig. 1. LC WPT is commonly implemented in the frequency range between several kHz and several MHz, but generally less than 10 MHz. To obey the various RF emissions norms, Rezence is operated at a frequency of 6.78 MHz in the ISM band [2].

II. SYSTEM DESCRIPTION AND WORKING

Rezence transfers power from a single Power Transmitter Unit (PTU) to one or more Power Receiver Units (PRU's.) The power transmission frequency is 6.78 MHz, and up to eight devices can be powered from a single PTU depending on transmitter and receiver geometry and power levels. The Bluetooth Low Energy (BLE) link in the Rezence system is intended for the control of power levels, identification of valid loads and protection of non-compliant devices. Figure 2 illustrates the basic system configuration between a PTU and a PRU. The PTU can be expanded to serve multiple independent PRUs. The PTU comprises three main functional units which are: a resonator and matching unit, a power conversion unit, and a signalling and control unit. The PRU also comprises of three main functional units like the PTU. [3]

The basic architecture of a Rezence network is a star topology network as illustrated by Figure 3. The PTU acts as the master and PRUs act as the slaves. There is a functional and physical separation between the wireless

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power transfer (strictly from PTU to PRU) and session and power control management (from PTU to PRU and PRU to PTU).

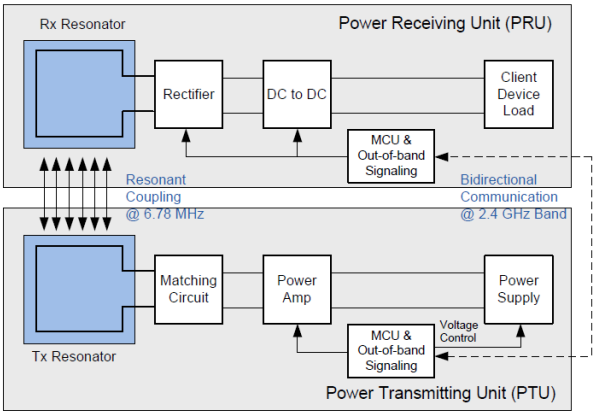

Fig. 2 Rezence WPT system

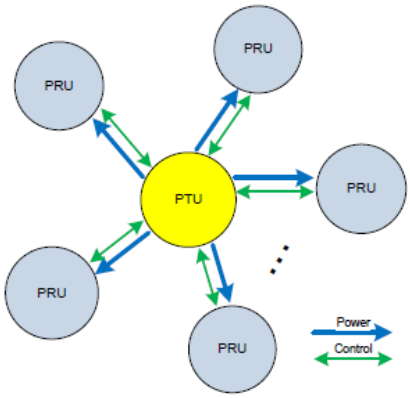

Fig. 3 Rezence multi-device charging architecture

The Rezence management protocol operates on a bidirectional half-duplex network channel. Communication is performed over the ISM band of 2.4 GHz. Rezence uses the existing Bluetooth Smart technology to communicate as it is widely present in smart phones and other devices and it is supported by the ISM band of 2.4GHz [1, 3].

The PTU creates and maintains the WPT network. The WPT process starts with the PTU in the PTU Power Save State, applying long and short beacons to the PTU resonator, to elicit a PRU response. Once a device is detected by the PTU, it transits to the PTU Low Power State, where it establishes a connection with the PRU, and exchanges the required information for WPT. After the completion of information exchange, charging is initiated with the PTU, writing a value to the PRU control of the PRU and it is delivered when the PTU has enough power to charge the PRU. [3]

III. ADVANTAGES

Rezence, unlike other WPT systems, is based on the principle of magnetic resonance while other systems, such as those based on the Qi standard, are magnetic induction based [4]. Rezence offers certain advantages over those systems.

A. Positional Flexibility

Rezence offers positional flexibility, unlike other WPT systems which require proper alignment between the device and the charging pad, making it possible for the consumer to have a true drop-and-go charging experience. [5] This is feasible because Rezence was designed keeping spatial freedom in mind. It is a LC WPT, which enables it to charge devices, kept at a reasonable distance from the transmitter, even in the presence of obstacles between the transmitter and the receiving devices [6].

B. Multi-Device Charging

Positional flexibility and the superior charging range of Rezence allow it to charge multiple devices with different power requirements at the same time. Up to eight devices can be charged at the same time with a maximum power transfer limit of 50 watts [1, 6].

C. Higher Frequency of Operation

While most WPT systems operate in the frequency range of 100 to 300 kHz, Rezence is operated at a much higher frequency of 6.78 MHz. Since, it operates at a high frequency, Rezence systems do not face metal heating and metal obstruction problems face by other WPT systems which operate at lower frequencies. Metal heating problems are faced by the Rezence systems in very limited and exceptional conditions, such as when very thin metals with large surface areas are kept near the systems. These can be avoided with a proper implementation of rogue object detection, as specified in the Rezence specification [7].

D. Real World Ready

Charging surfaces powered by Rezence can be attached to existing furniture and surfaces, as it is capable of charging devices through table tops which are as thick as 30mm. Since it is compatible with metal objects, it is the ideal choice for WPT systems in areas such as kitchens and automotives, where contact with metallic objects is inevitable [5, 8].

E. Bluetooth Communication

Bluetooth Smart provides a reliable communication channel between Rezence wireless power receivers and Rezence charging surfaces. This means that even the smallest of devices, such as headsets and wearables, would be able to communicate clearly, and not be overpowered by other devices that may be using the same charging station simultaneously. Communication takes place in the ISM band of 2.4 GHz. Since, most devices come equipped with Bluetooth, hardware requirements of the manufacturers are minimised. Bluetooth also provides a high bandwidth communication channel that could be utilised in the future for various value-added services, which could be incorporated within the system [9].

IV. LIMITATIONS

Despite the massive advantages, Rezence does possess a few limitations of its own.

A. Low Power Transfer Efficiency

LC WPT systems tend to suffer from flux leakage, thus reducing the power transfer efficiency of the system.

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Rezence, being a LC WPT, faces this issue. On the other hand, Qi, a Tightly-Coupled [TC] WPT system is more efficient than Rezence [12].

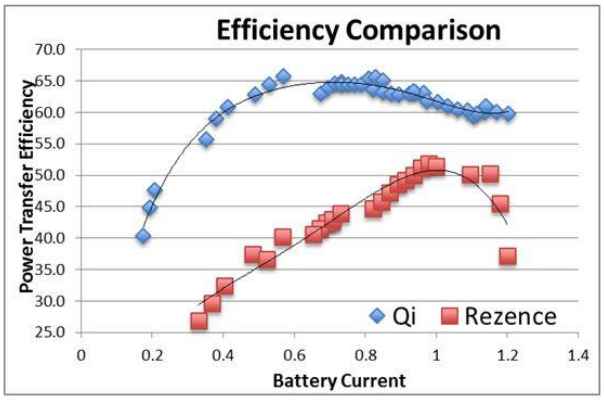

Fig. 4 Efficiency comparison between Qi and Rezence

B. Adoption Costs for Companies

The Qi standard has been in the market for a considerably long time. Companies that have invested in Qi products are less likely to switch to Rezence as they would have to incur greater expenses purchasing new equipment to integrate Rezence into their products. Also, there are a lot of Qi compatible devices already available in the market. These devices wouldn't be compatible with Rezence, thus making companies reluctant to make the switch to Rezence [13].

V. CONCLUSION

Rezence aims to bring a consumer friendly wireless charging solution to the global marketplace. To achieve this, A4WP has various major corporations as its members, such as Intel, Broadcom, Qualcomm, Samsung, etc. These corporations will work together to integrate Rezence into their products. Rezence faces major competition from the Qi standard, which has existed for quite some time. Qi has certain limitations such as single device charging, metal heating, positional alignment necessity, etc, which are absent in Rezence. However, Rezence has some limitations of its own. But, Rezence is still its developing phase and with further research and development, Rezence systems will truly be the "next-generation" of WPT systems.

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