TransferJet

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ABSTRACT
TransferJet is a new type of close proximity wireless transfer technology that is available from Sony .TransferJet solves the problem of complicated wireless settings and unstable data transfer which can cause problem in conventional wireless technologies and it features an easier user interface where the device connection is established automatically .Communication begins when one TransferJet device is held besides another with a maximum data transfer rate upto 560Mbit/sec .In this paper we give a review about this emerging technology and how it can mark the end of NFC .

Keywords
Coupler, MAC, OFDM, UWB, angular frequency.

1. INTRODUCTION
TransferJet is a new close proximity wireless transfer technology developed by the TransferJet Consortium. The main features of TransferJet are simple operation, safe connection and efficient transfer of data and thus the revolutionary technology enables rapid transfer of high resolution video, music and images with just a single touch. The concept of TransferJet consists of a touch-activated interface which can be applied for applications requiring high-speed data transfer between two devices in a peer-to-peer mode without the need for external physical connectors.
TransferJet's maximum physical layer transmission rate is 560 Mbit/s. After allowing for error correction and other protocol overhead, the effective maximum throughput is 375 Mbit/s. TransferJet will adjust the data rate downward according to the wireless environment, thereby maintaining a robust link even when the surrounding wireless condition fluctuates .TransferJet allows exchange of data even when multiple users are using the same technology without interference.
TransferJet has the capability of identifying the unique MAC addresses of individual devices, enabling users to choose which devices can establish a connection. By allowing only devices inside the household, for example, one can prevent data theft from strangers while riding a crowded train. If, on the other hand, one wishes to connect the device with any other device at a party, this can be done by simply disabling the filtering function.

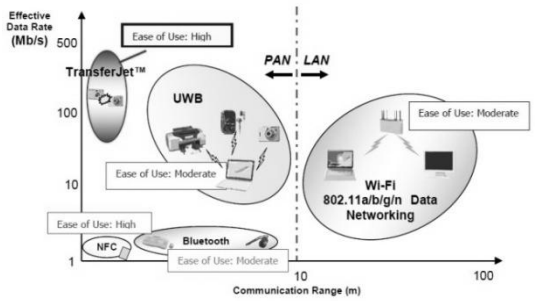

Fig.1: TransferJet™ offers a unique combination: high performance, high ease of use

By reducing the RF power and spatial reach down to a few centimeters (about an inch or less), a TransferJet connection in its most basic mode does not require any initial setup procedure by the user for either device, and the action of spontaneously touching one device with another will automatically trigger the data transfer. More complex usage scenarios will require various means to select the specific data to send as well as the location to store (or method to process) the received data.
TransferJet utilizes a newly developed TransferJet Coupler based on the principle of electric induction field as opposed to radiation field for conventional antennas. The functional elements of a generic TransferJet Coupler consist of a coupling electrode or plate, a resonant stub and ground. Compared to conventional radiating antennas, the TransferJet Coupler achieves higher transmission gain and more efficient coupling in the near-field while providing sharp attenuation at longer distances. Because the Coupler generates longitudinal electric fields, there is no polarization and the devices can be aligned at any angle. [1][7]

2. Specifications

Center Frequency	4.48 GHz
Bandwidth	560 MHz
Transmission Power	At or below -70 dBm/MHz (average) Corresponds to low-intensity radio wave regulation in Japan and Taiwan, and with local regulations in other countries and regions.
Transmission Rate	560 Mbit/s (max) / 375 Mbit/s (effective throughput) System can adjust the transmission rate depending on the wireless environment.
Connection Distance	A few cm (nominal)
Connection Topology	1-to-1, Point-to-Point
Antenna Element	Electric induction field coupler

Table 1.Specifications of TransferJet

NFC versus TransferJet
The idea of TransferJet is the same as NFC. It is designed for extremely short range (a few cm at most) one-to-one connections and data transfer. The thing is that where NFC has maximum throughput of about 424Kbps whereas TransferJet has a maximum throughput of 560Mbps. Additionally, NFC uses the globally available and unlicensed radio frequency ISM band of 13.56 MHz, making it easy to implement without interference. TransferJet uses the 560MHz band, which is part of the cable TV spectrum in the US, but because of the low power there is no real problem with

interference. Because of all this, NFC has found itself as the go-to protocol for things like mobile payment systems, or security badges, but TransferJet has become the go-to protocol for wireless syncing of devices .[3]

3. FEATURES

"Touch & Get" interface

By just touching two electronic products together files are transferred automatically. Transfer Jet eliminates the complex setup procedures required by existing wireless systems and it requires no access point. Furthermore, users are also able to register their electronic products to enable Transfer Jet to recognize specific products. Operation is also very intuitive, and as there is no host/target relationship, data transfer can take place between mobile phones and PCs for example, as well as between mobile devices.

Safe and Flexible

Transfer Jet has the capability of identify unique MAC addresses of individual devices, enabling them to choose which devices can establish a connection with them. By allowing only devices inside the household, for example, one can prevent data theft from strangers while riding a crowded train. If, on the other hand, one wishes to connect the device with any other device at a party, this can be done by simply disabling the filtering function. Transfer Jet uses the same frequency spectrum as UWB, but occupies only a section of this band available as a common worldwide channel. Since the RF power is kept under -70 dBm /MHz, it can operate in the same manner as that of UWB devices equipped with DAA functionality. In addition, this low power level also ensures that there will be no interference to other wireless systems, including other Transfer Jet systems, operating nearby.

Range

At centimeters might be considered a disadvantage. But when combined with the touch usage model, it actually offers tremendous advantages. We've already mentioned the low power consumption. In addition, the short range virtually eliminates any multipath fading or shadowing present in longer range solutions such as 802.11 or Bluetooth. Thus the connection is very reliable without the need for complex equalizers or advanced signals such as OFDM. This also helps to minimize cost and power consumption. But the biggest advantage is the ability for each TransferJet™ device to discover another TransferJet™ device that comes within range. Since the range is so short, the protocol can reach a key conclusion upon making this discovery: the user has just authorized a connection with the discovered device. Therefore, the protocol can connect the two devices with no further action required from the user. Once this connection is made, the application can take further steps such as transfer a file, query the user, display a file menu, etc. In this sense, the touch motion in the TransferJet™ world is similar to the cable plug-in action in the USB world.

Coupler

"Transfer Jet Coupler" is based on electric induction field coupling to deliver superior propagation performance compared to conventional radiation field based antennas. It maintains high transmission gain and efficient coupling in near-field proximity, while providing sharp attenuation over longer distances to avoid interference with other wireless systems.

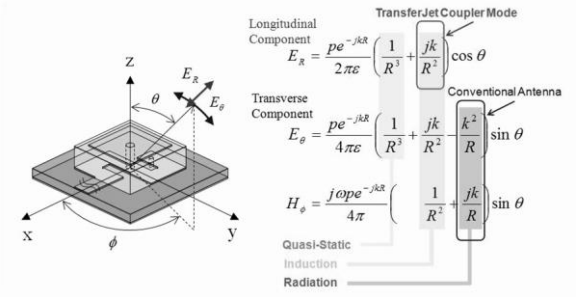

Fig. 2: TransferJet™ Coupler design and field equations for an ideal dipole

The variables in the above equations are as follows:

R = range or distance from the dipole in meters k = or angular wave number of a plane wave p = QL (where Q is the peak charge and L is the length of the dipole) = angular frequency of the sinusoid in radians/sec = permittivity of the propagating medium (air) = permeability of the propagating medium (air) Notice the field strength of the far-field parts of the signal vary inversely with range. The near field parts, on the other hand, vary inversely with the square of range. Therefore, the near field intensity drops off much faster with range than the far field. The far field also radiates real power. The far field transverse E and H components form the conventional TEM or Transverse Electro-Magnetic wave so common in wireless communications. By contrast, the near field is inductive because it does not radiate real power but instead stores power in the near field. The inductive power is only dissipated if another TransferJet™ coupler appears in the near field. Finally, the near field contains a longitudinal component. This component is important because it is not polarized, making it much easier for the user to align two devices as previously mentioned. μεω ω ε μ

All these factors are combined to produce the unique TransferJet™ coupler. The design of one such coupler is shown in Figure 2 along with the coordinate system from the ideal dipole analysis. This coupler is not a conventional antenna but instead is designed to suppress the far field component and emphasize the near field signal. The approach creates a virtual bubble of signal energy that drops off very quickly at any range beyond a few centimeters. The result is a usable sensitivity within this distance range. Two typical TransferJet™ devices establish a connection when brought together. But once established, the link will not break unless the devices are separated beyond the bubble distance. This "soft" engage feature further enhances the convenience and ease to the end user.

Stable High Speed Data Transmission

Transfer Jet's physical layer transmission rate is 560Mbps, and even allowing for error correction and other protocol overhead, the effective maximum throughput is 375Mbps. Transfer Jet will adjust the data rate downward according to the wireless environment, thereby maintaining a robust link even when the surrounding wireless condition fluctuates. As Transfer Jet is a close proximity wireless system which radiates very low-intensity radio waves, it causes almost no interference to other wireless systems, and there is no impact to performance even if multiple users simultaneously multiple Transfer Jet system. Moreover, users of electronic products incorporating Transfer Jet technology are able to transfer data among each other's products regardless of whether they are indoors or outdoors and irrespective of their geographic location.

4.WORKING

Any two devices will be able to exchange data (wireless) with one another simply by holding them close to each other. The two devices must have the appropriate chip embedded inside. The system is designed for maximum ease of use, which means limited options for controlling the transfers. Devices will transfer their contents automatically to another device within range. Users can "register" devices within the home to keep them from transmitting to "unregistered" devices. TransferJet uses 4.5GHz electric induction field, instead of radio, as a transmission medium. It's as if an electric field is vertically vibrating between couplers of a transmitter and a receiver. This electric inductive field sharply loses power when it is several centimeters away, which is almost equivalent to 4.5GHz band's wavelength. Accordingly, electromagnetic fields generated by TransferJet transceivers never interfere with other wireless devices. In exactly the same way, unless the field is placed within a distance of several centimeters, TransferJet never gets interference from other UWB wireless devices.

5. SECURITY

Although TransferJet™ is a near field, point-to-point technology; it is still a wireless network. Wireless networks such as 802.11 and Bluetooth have extensive and complex encryption technology built in to the link layer to make sure that an unauthorized receiver cannot access private information. Such link layer encryption is necessary for long range networks because it is impossible to physically restrict access to the network as would be possible with a cabled solution such as Ethernet or USB.

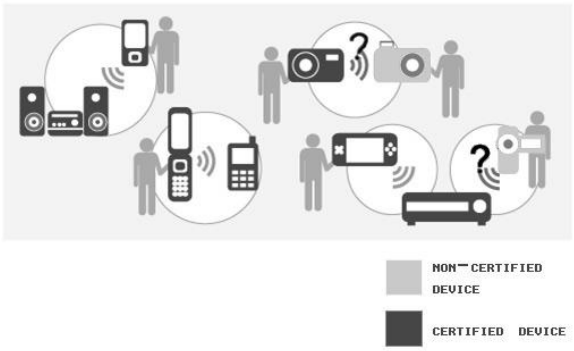

Fig. 3: TransferJet Compliance Program reassures connectivity & interoperability with corresponding TransferJet devices

For security purposes, TransferJet™ is more like a physical cable. Therefore, it intentionally has no encryption built into the link layer. It would be very difficult for an attacker to gain access to a TransferJet™ connection from some distant location. The attacker would have to be physically a few centimeters away in order to access the connection. If the attacker has to be that close, couldn't they just as easily plug in a USB cable? And remember, everything about TransferJet™ is designed to restrict both the signal level and range of the radiated signal. By eliminating link layer security, TransferJet™ saves power and cost, and further reduces complexity for the user. But it is possible to add encryption at the application layer. Some applications must protect a file's integrity during file transfer regardless of the connection type. TransferJet™ is perfectly compatible with these application-level security measures. Since each device has a unique ID, it is possible to uniquely identify any device that attempts to establish a connection. So TransferJet™ achieves the best of both worlds, the simplicity of touch, with the security of a cable.

6. PROTOCOL STACK

The TransferJet™ protocol operates under three basic principles:
Point-to-point: Connections are always point-to-point. Multi-point topologies are not supported.
Symmetry: All devices are capable of initiating or receiving a connection request.
Backwards compatibility: The protocol should be as backwards compatible as possible with existing legacy architectures.

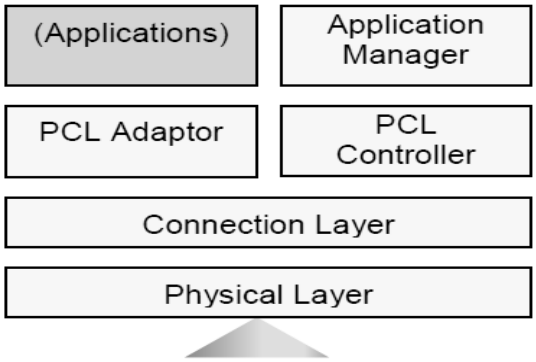

Fig. 4: TransferJet Protocol Stack

To implement these principles, the TransferJet™ protocol defines three layers: The Protocol Conversion Layer (PCL), the Connection Layer (CNL), and the Physical layer (PHY) as shown in the figure 4.
The Physical layer, or PHY, implements the actual radio. This layer converts the digital information into an RF signal suitable for transmission across the TransferJet™ couplers. The Connection Layer, or CNL, manages connections and data delivery. For connection management the CNL is responsible for establishing and releasing the connection to a peer TransferJet™ device. For data delivery, the CNL provides packets to carry the data payload and confirm successful delivery of those packets to the peer device. The Protocol Conversion Layer, or PCL, is responsible for converting from an Application's existing interface standards (such as SCSI or OBEX), and the TransferJet™ native protocol. In this way, for example, a stationary device can access data on a mobile device without modification to the application layer software. There is also a separate Application Management Layer being developed that coordinates and manages the applications, as well as guidelines that define how devices should provide feedback to inform the user of the progress of a transfer operation.

7. APPLICATIONS

This powerful combination of touch and speed enables high speed transfer of large data files (photos, video, images, etc) between two electronic products such as mobile phones, digital cameras, camcorders, computers, TVs, game products, and printers. Using this technology in its simplest form, data can be sent at high speed with just a single touch. Other cases involving more complex usage scenarios may require additional user interaction to select the specific data to send as well as the location to store (or method to process) the received data. From a user standpoint, Transfer Jet can be thought of as a universal touch-activated interface which

instantly connects a wide variety of consumer (and non-consumer) electronic products. For example, a family can display digital photos on their TV just by touching the camera to the TV or Transfer Jet pad connected to a STB. A tourist can archive digital video simply by placing the camcorder close to the PC. And students can share music with friends merely by touching the cell phone to the music player.

8. CONSORTIUM

Clearly, the technology offers significant benefits to the end user. But any data transfer requires two TransferJet™ devices in order to define a use case and complete a transaction. Therefore, multiple products must adopt TransferJet™ in order for it to be successful in the market. That is the purpose of the TransferJet Consortium (www.transferjet.org/en). As of spring 2009, the consortium consists of the following Promoter companies.

♦ Sony Corporation ("TransferJet Consortium" Administration)
♦ Canon Inc.
♦ CASIO COMPUTER CO.,LTD.
♦ Eastman Kodak Company
♦ Hitachi Ltd
♦ JVC KENWOOD Holdings, Inc
♦ KDDI Corporation
♦ NEC Corporation
♦ NIKON CORPORATION
♦ NTT DOCOMO, INC.
♦ Olympus Imaging Corporation
♦ Panasonic Corporation

9. FUTURE

Most of us don't even have Smartphone that feature NFC connectivity just yet, but work is already well underway on several technologies that aim to take the protocol's place as the next generation of short-range wireless communication. Nevertheless, Sony has announced a new chip that sounds like it could be the basis of just such an NFC-killing system, capable of some impressive data speeds.

Sony is one of many companies involved in the development of TransferJet, a wireless communication system designed for device-to-device interaction. Sony has already revealed its attempt at commercializing the technology, announcing a component that could start bringing TransferJet to consumer electronics by this time next year. Like NFC, TransferJet requires devices be placed very near to each other it has a maximum range of just a few centimeters. What it lacks in the ability to transmit data long distances, it makes up for in speed, hitting over 350Mbps with this Sony component.

10. CONCLUSION

TransferJet is a new wireless technology that combines the speed of UWB (Ultra-Wide Band) with the ease of NFC (Near Field Communications). By doing so, TransferJet™ delivers a transfer speed of 560 Mbps available to the end user through a simple "touch". This paper presents a solution – TransferJet– which solves the content sharing problem in a way that also achieves high performance, low cost, high security, and most importantly, extreme ease of use.

11. REFERENCES

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