TransferJet

Worlds are About to Touch

TransferJet Whitepaper

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TransferJet Consortium

INTRODUCTION

Two worlds exist for today's consumer: content playback and content creation. The traditional end user still consumes multimedia content by watching TV, listening to music, and viewing family photos. At the same time many end users also spend almost as much time producing content. They produce photos and videos by using cameras and camcorders. The reason this has become so popular is simple: it is very easy to create content with modern equipment. But there is a problem. Content is easier to create than to transfer. This limits the potential for playback and sharing, and creates a kind of bottleneck between content creation and content consumption. For example, it is not so easy when end users want to post high-resolution photos taken by high performance digital SLR, to Social Network Services in timely manner. Nowadays, content sharing between devices has more and more opportunities. This white paper presents a solution – **TransferJet** – which solves the content sharing problem in a way that also achieves high performance, low cost, high security, highly intuitive, and most importantly, extreme ease of use.

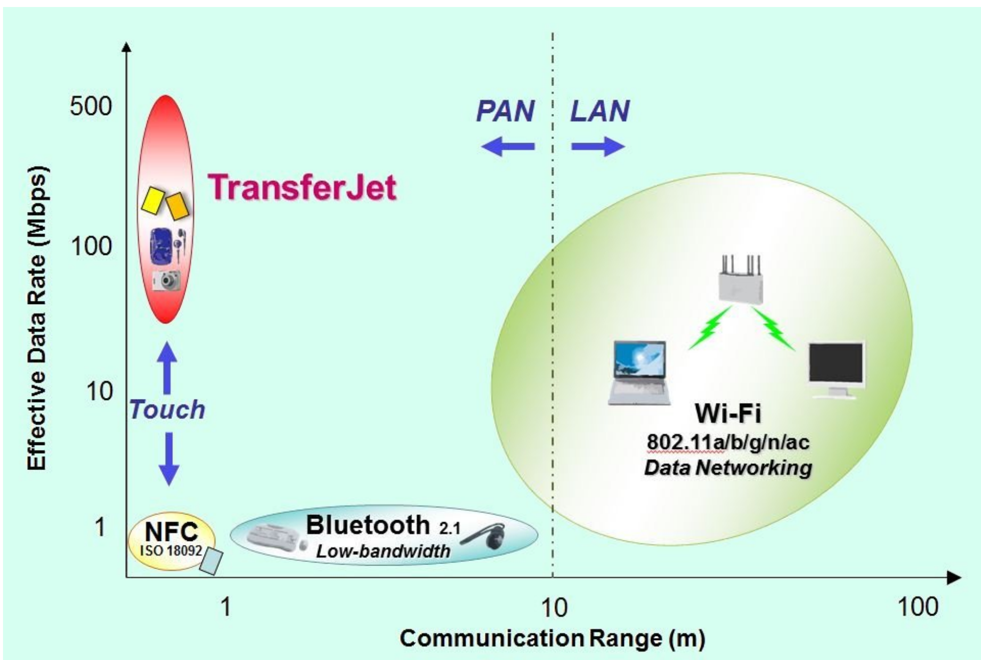

Figure 1：Positioning of various wireless technology.

TransferJet is a new wireless technology that combines a data transfer rate faster than *Wi-Fi* with the ease of NFC (Near Field Communications). This combination enables **TransferJet** to deliver a transfer speed of 560 Mbps available to the end user through a simple "touch" operation.

"*TOUCH*" MODEL

How does **TransferJet** achieve all this? The key lies in the "touch" model of user operation. This model requires only a simple touch motion from the user to make things happen. Touch is such a natural motion that people tend to "get it" very quickly. Consider the case of the train network in Japan. Japanese train systems adopted touch for the access gates in all stations. The system was so successful that within a year or so after deployment it was fully adopted by the general public. It takes only a fraction of a second to pay the train fare by touching a payment IC card to the card reader while walking through the gate. Today it is very common for millions of people to stream through these gates each day, making a touch transaction on every pass. In fact, it is difficult to find passengers using traditional paper tickets. Similar NFC technologies have been adopted in other payment applications such as bus fares, taxi fares, shops, restaurants, and so on. Clearly, touch is a very natural and intuitive motion. That is why **TransferJet** utilizes this same touch motion and extends the performance to also support high speed data transfer.

USE CASES

This powerful combination of touch and speed enables high speed transfer of large data files (photos, video, etc.) between two devices including TVs, smartphones, PCs, tablets, camcorders, digital still cameras, gaming consoles and printers. **TransferJet** enables high speed data transfer triggered by just a single touch. Or, more complex usage scenarios which require additional user interaction to select the specific data to send, to select the specific location to store (or method to process) the received data can also be implemented. From a user standpoint, **TransferJet** can be thought of as a universal touch-activated smart interface which instantly connects a wide variety of electronic devices. For example, family photos might be displayed on a TV just by touching the camera to the TV or a **TransferJet** pad connected to a STB. Hi-resolution photos captured by a high performance digital SLR can be posted to social networks and blogs in a timely and efficient manner by touching the camera to the smartphone or tablet. Anyone can enjoy TV programs on the go by touching the smartphone to the STB and instantly transferring HD programs.

Figure 2: Displaying digital photos on the TV by simply touching the camera

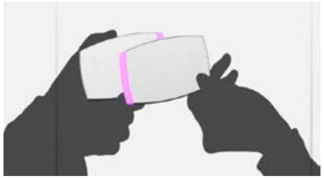

Figure 3: Transferring digital files on the go

Figure 4: Downloading digital contents to a mobile device by touching a digital signage spot

The ease of use enhances these traditional use cases but also creates new possibilities. For example, it is possible to create digital signage and digital kiosks with new features and capabilities. A person might get files such as coupons, movie trailers, and sound clips by touching the smartphone or tablet to **TransferJet** pads placed in public locations. A theme park visitor could download electronic maps and event schedules by touching **TransferJet** pads placed at the park entrance and other locations.

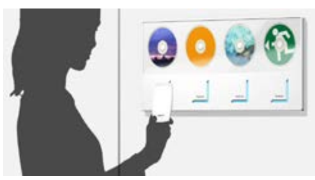

Figure 5: Sampling/downloading music files to a mobile device by touching a music kiosk panel

Additional use cases might exploit the contactless nature of **TransferJet** and thus eliminate the risks associated with traditional connector pins that might corrode, bend, or break. Such properties make **TransferJet** ideal in harsh or demanding environments such as manufacturing plants, shipyards, clean rooms, and medical environments.

SPECIFICATIONS

Clearly, the unique qualities of **TransferJet** make it useful for many applications. Let's delve a little deeper into the technical details. **TransferJet** can transfer data at a peak speed of 560 Mbps, with an effective throughput up to 375 Mbps. The maximum range of operation is on the order of a few centimeters and the network topology is always point-to-point. These last two features greatly enhance the simplicity of the system. The short range makes it possible to operate in the near field of the radio signal using very little transmission power – less than -70 dBm/MHz. The point-to-point topology greatly simplifies the setup and management procedures. And since the near field electric induction field is non-polarized, the two devices do not have to be precisely oriented to achieve a good connection. The spectrum is centered at 4.48 GHz, and occupies a bandwidth of 560 MHz. This choice of spectrum, coupled with extremely low transmission power, enables unlicensed operation in Japan, Europe, the US and many other regulatory domains. In addition, **TransferJet** contains a robust protocol which includes error detection and correction, packet acknowledgement, and packet resend. All of these details work together to minimize complexity and RF interference. The low transmission power and point-to-point topology help to minimize power consumption. Finally, each **TransferJet** device can detect the presence of another device as it comes within range. Therefore, it is possible to save power by transmitting only when another device is detected. This is another advantage of the touch model.

Center Frequency	4.48 GHz
Transmission Power	Below -70 dBm/MHz (average) It satisfies regulatory requirement in many countries and regions, such as ETSI EN 302 065. Also, in case of this system, it is confirmed to meet the requirement of low-intensity radio wave regulation in Japan.
Transmission Rate	560 Mbps (max)/375 Mbps (effective throughput) System can adjust the transmission rate depending on the wireless environment.
Connection Distance	A few centimeters
Topology	1-to1
Antenna Element	Electric induction field coupler

Figure 6: **TransferJet** Specifications

RANGE

At first glance, the short range of a few 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 problems with multipath fading or shadowing which plague longer range solutions such as *Wi-Fi* or *Bluetooth*. Thus the connection is very reliable without any need for complex equalizers or advanced modulation schemes 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. One might say that **TransferJet** provides the ease of a USB cable – without the cable. As with every other wireless protocol, devices must proceed through the necessary stages – search, discovery, selection, authentication, connection, and transfer – in order to complete a desired activity. But **TransferJet** is unique because all these steps are collapsed into a single motion: the “touch”.

COUPLER

It may come as a surprise that limiting connectivity to a predetermined short range is inherently difficult. Remember, if two **TransferJet** devices are not in contact (or near-contact) with each other, they should do nothing - not even detect each other's presence.

That is a very tricky task for a conventional antenna. A typical antenna is designed to radiate a signal as far as possible. To better understand this behavior, consider the field equations shown below for an ideal dipole excited by a sinusoidal current.

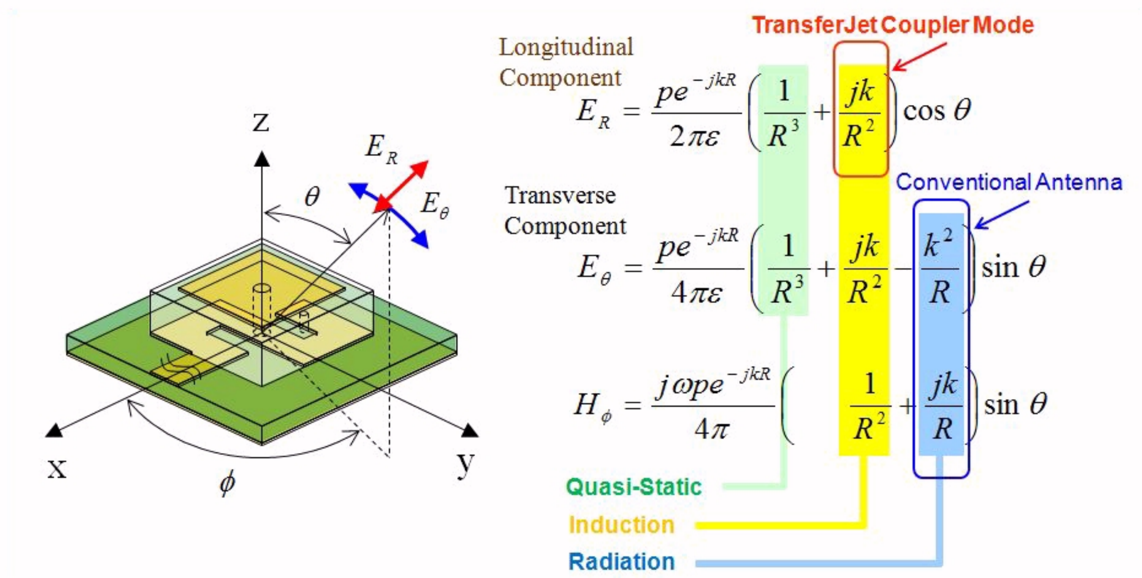

Figure 7: **TransferJet** Coupler design and field equations for an ideal dipole.

The variables in the above equations are as follows:

- R = range or distance from the dipole in meters
- k = $\omega\sqrt{\mu\varepsilon}$ or angular wave number of a plane wave
- p = QL (where Q is the peak charge and L is the length of the dipole)
- ω = angular frequency of the sinusoid in radians/sec
- ε = permittivity of the propagating medium (air)
- μ = 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 transverse electromagnetic (TEM) wave 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.

All these factors are combined to produce the unique **TransferJet** coupler. The design of one such coupler is shown in Figure 7 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 engagement” feature further enhances the convenience and ease to the end user.

SECURITY

Although **TransferJet** is a near field, point-to-point technology, it is still a wireless network. So is it secure? This is a very key question. Wireless networks such as *Wi-Fi* and *Bluetooth* have extensive and complex encryption technologies 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. 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, they might just as well plug in a USB cable. 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 and freedom of touch, with the security of a cable.

PROTOCOL STACK

The **TransferJet** protocol operates under three basic principles:

1) Point-to-point: Connections are always point-to-point. Multi-point topologies are not supported.
2) Symmetry: All devices are capable of initiating or receiving a connection request.
3) Backwards compatibility: The protocol should be as backwards compatible as possible with existing legacy architectures.

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.

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. As of June, 2015, OBEX, SCSI (incl. SD over SCSI), PTP/MTP, Serial Port, and TCP-IP are supported in the form of PCL specifications.

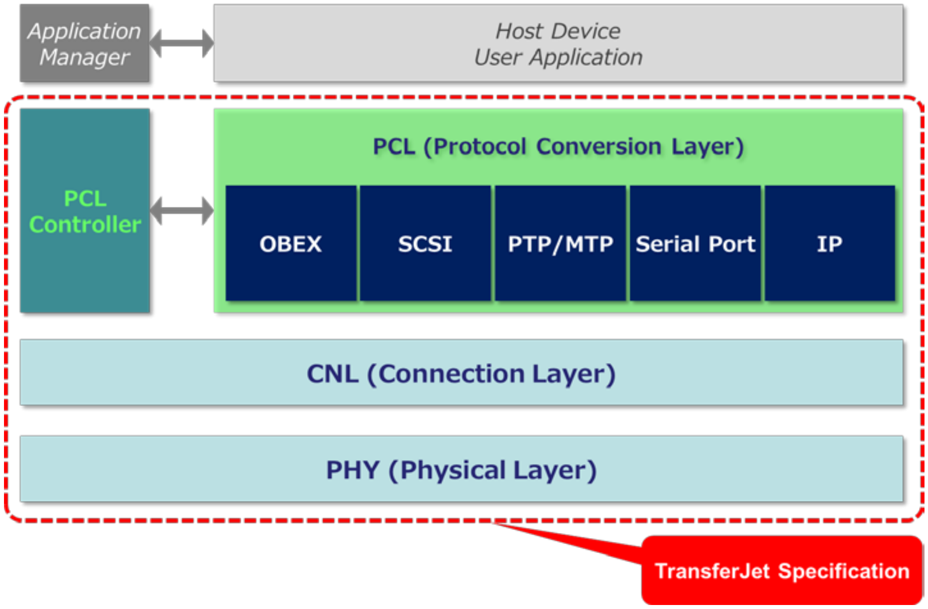

Figure 8: **TransferJet** Stack Architecture

REGULATORY

Since **TransferJet** communicates using a radio signal, it must comply with government regulations in any geographic region in which it operates. In the regions that have clearly established regulations, including Japan, Korea, China, the EU, and the US, **TransferJet** is compliant for operation indoors or outdoors. The regulatory situation of major region is shown below.

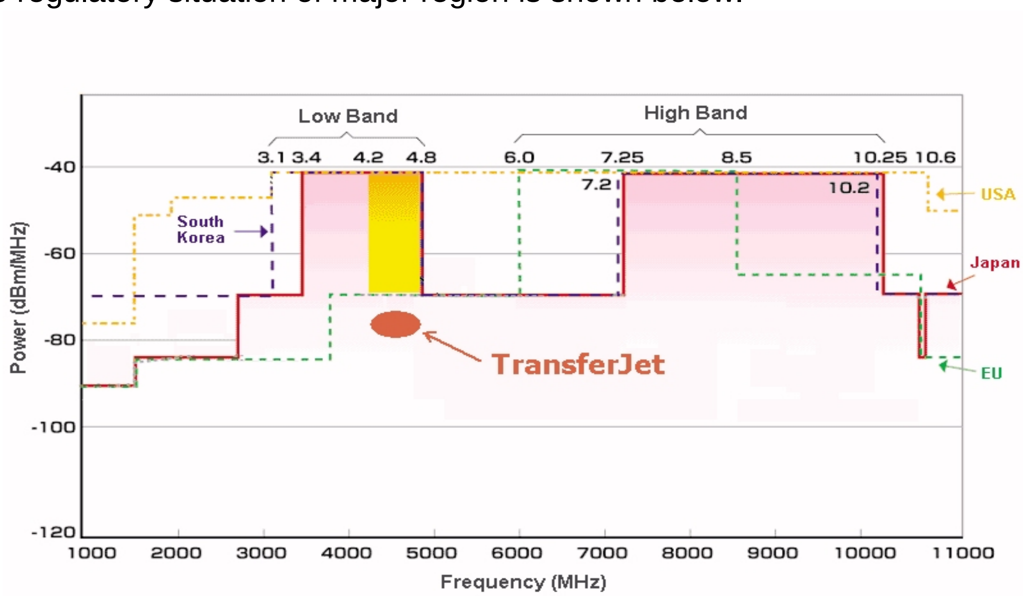

Figure 9: UWB Regulatory Landscape

TransferJet 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).

TransferJet Consortium has two classes of membership: Adopters and Promoters. Adopters will be able to access, as licensees, documents including all technical specifications and guidelines related to TransferJet, in order to develop, manufacture, and sell products compliant with those specifications and guidelines. Promoters participate in the development of the technical and compliance specifications as well as the overall management and operation of the consortium.
The TransferJet specifications include protocols, architecture, use cases, test specification, certification program, trademark guideline and son on.
Core part of the TransferJet technical specifications have also been officially approved as an ISO/IEC17568 standard.

Figure 10: Brand Logo

Figure 11: Symbol Logo

Figure 12: Target Point Logo

Figure 13: Example of Target Point Logo Placement