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Advanced Communication Through Flesh Red Tacton - Human Area Networking Technology

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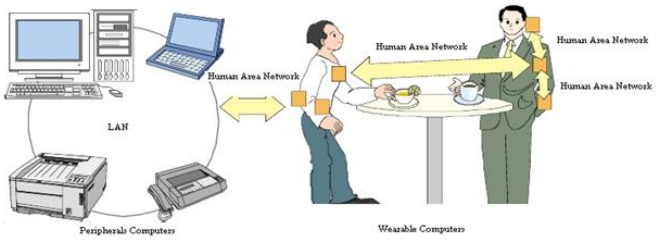
***Abstract- All the* user-friendly services require technologies that enable communication between people and objects in close proximity. This paper describes a model of human area networking technology that enables communication by touching, a technology we call Red Tacton. Human area networking technology for communication between mobile terminals and between terminals that are embedded in the environment has become important. When cables are used for communication between terminals, the routing of the cables is clearly inconvenient. When very weak radio signals are used for the communication, data speeds are reduced by packet collision and other such problems in crowded places such as exhibition sites and security risk from unwanted signal interception is another problem. Technology for solving such problems includes the use of the person body as a signal path for communication. A transmission path is formed automatically when a person comes into contact with a device and communication between mobile terminals begins. Here, the human body acts as a transmission medium supporting IEEE 802.3 half duplex communication at 10Mbit/s.**
***Keywords*- Red Tacton, Human Area Networking, Communication through Touch Technology.**

I. INTRODUCTION

In today's world, people can communicate anytime, anywhere and with anyone over a cell phone. Also, through internet people can download large quantities of quality data from remote locations. These technologies facilitate far-away communication for the users. Most electronic devices including personal digital assistants (PDA's), pocket video games and digital cameras have reduction in size, so that they can be carried around and used at the instance of requirement. These are used to carry various personal or public information and communications in everyday activities. However, user friendly ubiquitous services involve more than just networking between remotely located terminals. Communication between electronic devices on the human body (wearable computers) and ones embedded in our everyday environments such as illustrated in fig.1 is also critical, so this has driven extensive research and development on human area networks. Wired connections between electronic devices in human area networks are cumbersome and can easily become entangled. Short range wireless communication systems such as Bluetooth and wireless local area networks (IEEE 802.11b, etc.) have some problems. Throughput is reduced by packet collisions in crowded space such as meeting rooms and auditoriums filled with people and communication is not secure because signals can be intercepted. The principle drawback of infrared communication (IrDA) is the tight directionality of beams between terminals is needed for the system to be effective.

The ultimate human area network solution to all these constraints of conventional technologies is "intra body" communication, in which the human body serves as the transmission medium. In ubiquitous services (which imply communication between electronic devices embedded in the environment in close proximity to people), if we could use the human body itself as a transmission medium, then this would be an ideal way of implementing human area networks because it would solve at a stroke all the problems including throughput reduction, low security and high network setup costs.



The concept of intra body communication, which uses the minute electric field propagated by the human body to transmit information, was first pro-posed by IBM [1]. The communication mechanism has subsequently been evaluated and reported by several research groups around the world. However, all those reported technologies had two limitations:

1) The operating range through the body was limited to a few ten of centimeters
2) The top communication speed was only 40kbit/s.

These limitations arise from the use of an electrical sensor for the receiver. An electrical sensor requires two lines (a signal line and a ground line), whereas in intra body communication there is essentially only one signal line i.e. the body itself, which leads to an unbalanced transmission line, so the signal is not transmitted correctly.

II. HUMAN AREA NETWORK

NTT has had excellent success with an electro-optic sensor combining an electro-optic crystal with laser light and recently reported an application of this sensor for measuring high frequency electronic devices [2],[3].

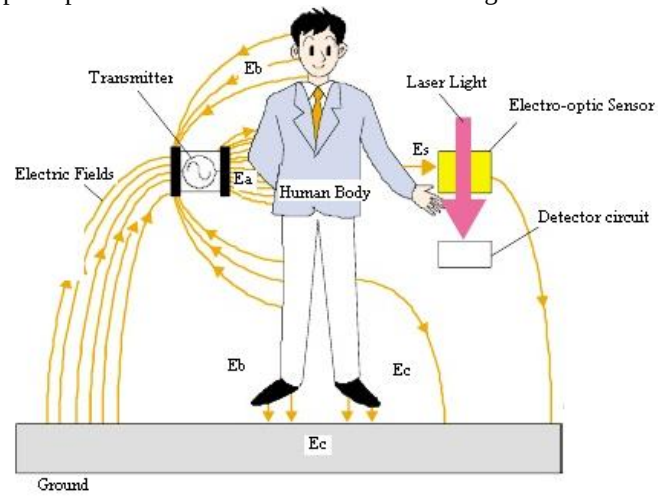
The electro–optic sensor has three key features:

1) It can measure electric fields from a device under test (DUT) without contacting it, which minimizes measurement disturbance,

2) Ultra wide band measurement is possible, and

3) It supports one point contact measurement that is independent of the ground, which is the most significant feature in the present context.

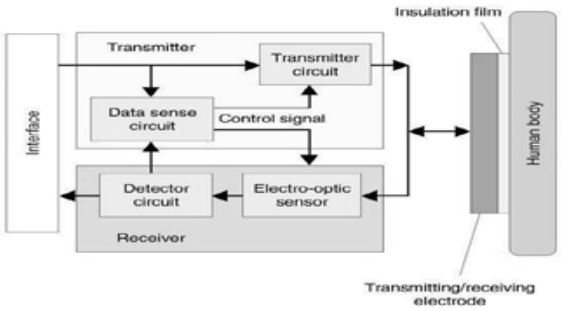
NTT utilized this third feature to fabricate an intra body communication receiver for its human area networking technology, which is called Red Tacton. The operating principle of Red Tacton is illustrated in the figure below:



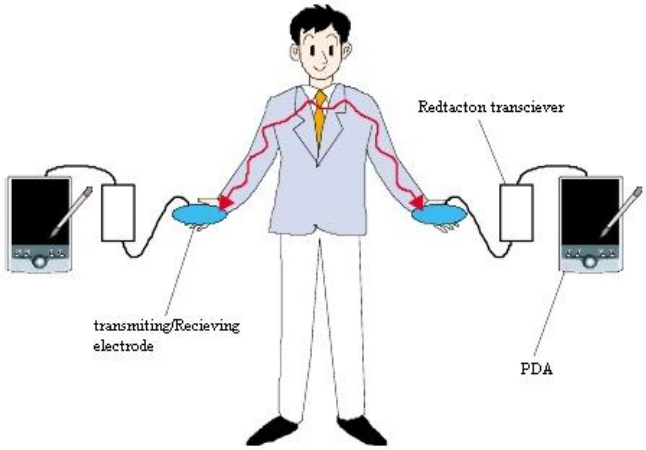
The electric field induced towards the body by the transmitter's signal electrode is represented by Ea. The system requires a ground close to the transmitter signal electrode, so electric field Eb induced from the body can follow a return path to the transmitter ground. Moreover, since people are usually standing on a floor or the ground, electric field Ec escapes from the body to ground, mainly from the feet. The electric field Es that reaches the receiver is Es= Ea-(Eb +Ec). It couples to the electro-optic crystal and changes the crystal's optical properties. This change is detected by laser light and transformed into digital data by a detector circuit.

III. RED TACTON TRANSCIEVER

Following is block diagram of a Red Tacton Transceiver [4]. The signal from the interface is sent to the data sense circuit and the transmitter circuit. The data sense circuit senses the signal and if the data is present it sends control signal to the transmitter which activates the transmitter circuit. The transmitter circuit varies the electric field on the surface of our body. This change in the electric field is detected by the electro-optic sensor.



The output of the electro-optic sensor is given to the detector circuit, which in turn given to the interface of the receiving Red Tacton device The experimental setup for intra body communication assuming communication between two electronic devices (PDAs) is shown in the figure below:



We prepared two sets of Red Tacton transceivers, each connected to a PDA. The subject held one transmitting/receiving electrode in each hand. We quantitatively measured the bit error rates of signals sent through the body. The results showed that the system had no significant practical problems at a transmission speed of 10 Mbit/s. besides communication between two hands; we also demonstrated reliable communication between a foot achieved not only when the electrodes were in direct contact with the person's skin but also when the signals passed through clothing and shoes.

IV. HUMAN SAFETY

We investigated the effects of Red Tacton technology on human health, which is obviously an important issue. First as shown in figure on the previous page, the transmitting and receiving electrodes of the Red Tacton receiver are completely covered with insulating film, so the body of the person acting as a transmission medium is completely insulated. This makes it possible for current to flow into a person's body from a transceiver. When communication occurs, displacement current is generated by the electrons in the body because the body is subjected to minute electrical fields. However such displacement currents are very common everyday occurrences to which we are all subjected.

Red Tacton conforms to the "Radio Frequency-Exposure Protection Standard (RCR STD-38)" [6] issued by the association of Radio industries and business

(ARIB). The levels produced by Red Tacton are well below the safety limit specified by this standard.

V. APPLICATIONS OF RED TACTON

In this section we highlight three distinctive features of Red Tacton:

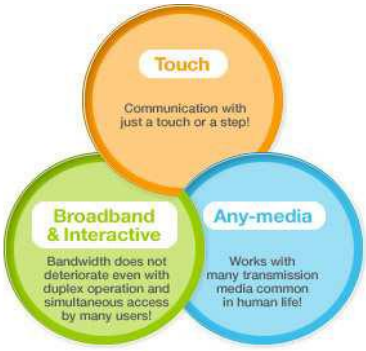


Fig : Features of Red Tacton

A. *Touch:* Touching, gripping, walking, sitting, steeping and other human movements can be the triggers for unlocking or locking, starting or stopping equipment, or obtaining data.

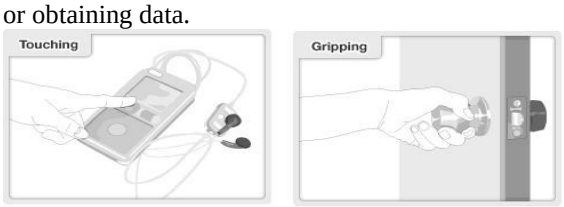


Fig (a)

B. *Broadband and interactive*: Duplex, interactive communication is possible at a maximum speed of 10Mbps. Because the transmission path is on the surface of the body, transmission speed does not deteriorate in congested areas where many people are communicating at the same time.

Communication speed can deteriorate in crowded spaces due to a lack of bandwidth. Device drivers can be downloaded instantly and executable programs can be quickly sent.

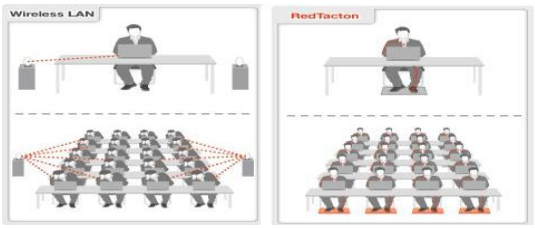


Fig (b)

C. In addition to human body, various conductors and dielectrics can be used as transmission media. Conductors and dielectrics may also be used in combination.

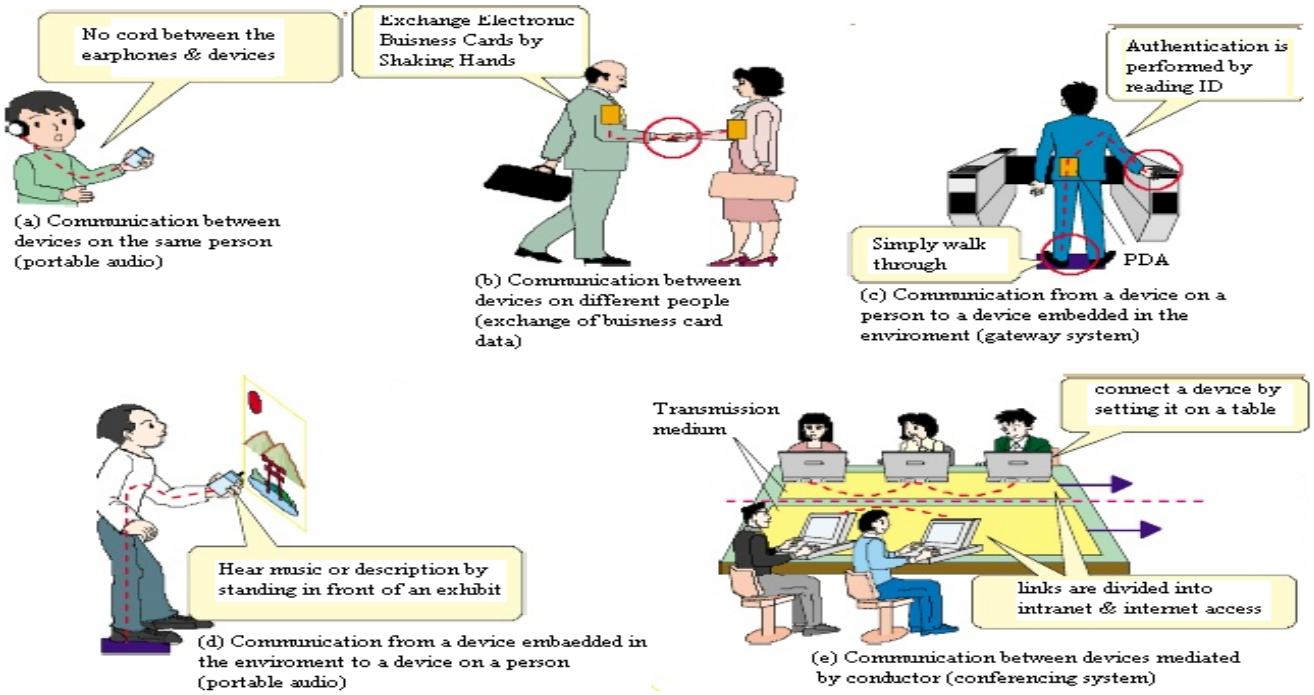
Fig (c): (Signals pass through materials)

A communication environment can be created easily and at low-cost by using items close at hand, such as desks, walls, and metal objects. But there is one limitation on the length of the conductor to be propagated, on installation locations, and on the thickness of the dielectric to be passed through. Some representative applications of Red Tacton are shown in these figures.

Fig.(a) illustrates communication between mobile electronic devices on one person. In this case, the person is listening to music from a portable audio device through earphones. Instead of a physical cord tethering the two devices, the data is passed through the person's body. Similarly, one could envision a worker wearing a head-mounted display performing a complex task based on instructions from a pocket sized computer.

Fig. (b) shows communication between devices on different enabling them to exchange electronic business cards by shaking hands. Fig (c) illustrates communication between an electronic device on a person and one embedded in the environment. One can easily think of a wide variety of applications of this type. For example, a person might carry a PDA that transmits an ID or a simple script (computer program) to a device embedded in the environment. Then, when the person briefly touches the system or simply walks through a gate, the transmission could trigger various kinds of action such as opening the gate or assessing the toll or charge. A natural gesture such as turning a knob to open a door could enable identification and authentication of the person seeking admission.

It illustrates a system where a metal surface acts as the conductor of electric field instead of a human body. A conductive metal sheet is placed on the top of a table, and a conferencing system is created simply by placing devices on it. Laptop computers could be connected to the internet by simply placing them on the table. Even different networks could be supported such as an enterprise LAN (local area network) and internet access, by providing separate metal sheets for each network.



VI. CONCLUSION

Red Tacton is an exciting new technology for human area networking. We have developed a transceiver that uses a human body as a data transmission medium based on electric field sensor that uses an electro-optic crystal and laser light. Using this transceiver, we succeeded in achieving 10BASE communication in accordance with IEEE 802.3 through a human body from one hand to other hand. While our main objective is to implement a Red Tacton system supporting two-way intra body communication at a rate of 10Mbit/s between any two points on the body, our longer term plans include developing a mass market transceiver interface supporting PDA's and notebook computers while continuing efforts to reduce the size and power consumption of the transceiver to enhance its portability. NTT is committed to using its comprehensive commercialization functions to push this research out to the market place as quickly as possible while moving ahead with tests and trials in collaboration with commercial partners as necessary [6].

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