TAP: Touch And Play

Park Duck Gun

Basics Research Laboratory

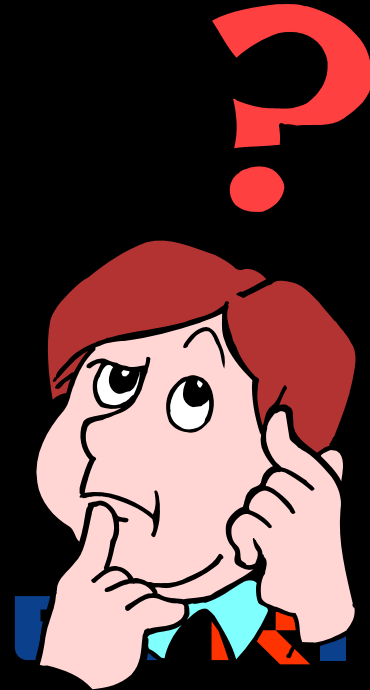**Electronics and Telecommunication Research Institute**

Evaluation of CHI Madness

- **How many people in this room decided to see my work after seeing the CHI madness?**

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Single Question:

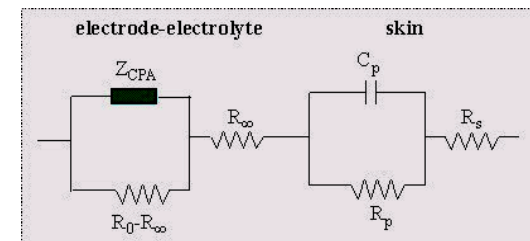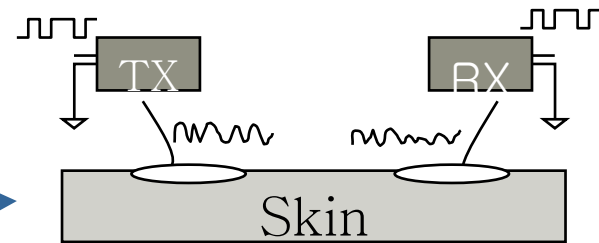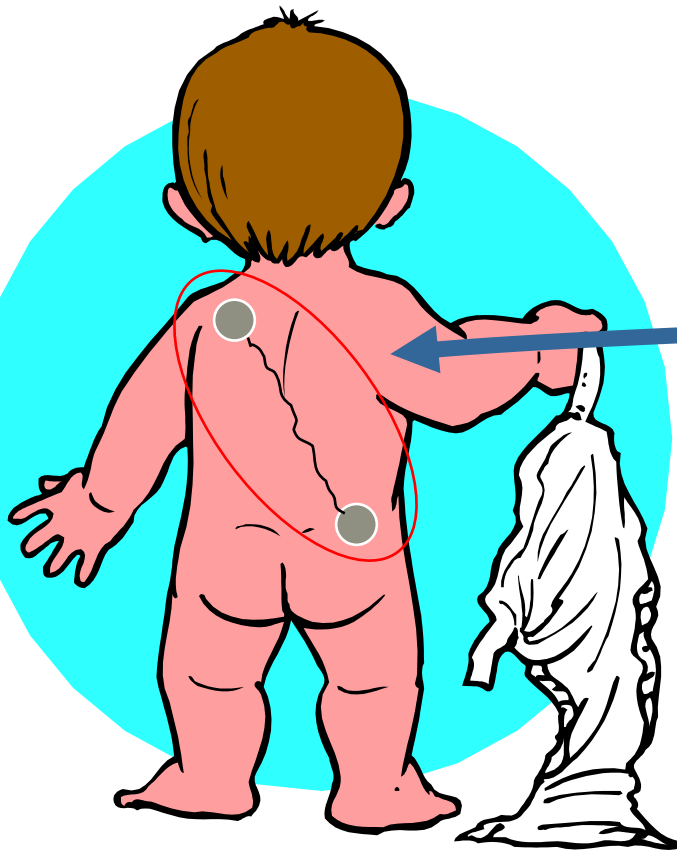**Will Intra-body signaling be useful in future of ubiquitous computing?**

Excuse me, sir.
What is intra-body signaling?

Audience Quiz:

- **How many people in this room ever heard intra-body signaling or something like it?**

Intra-body Signaling Simplified

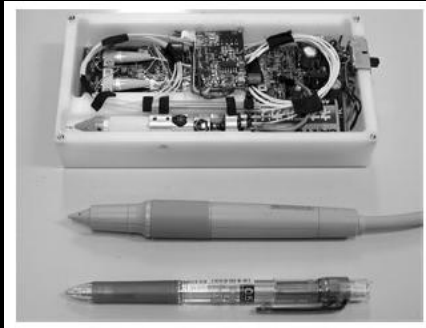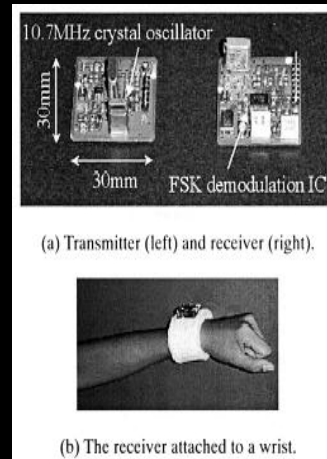# Previous studies

- **MIT, IBM Zimmerman**

- **Sony**

- **Washington Univ**

- **Tokyo University**

- **NTT DoCoMo**

- **It's 10 year old technology**

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Previous studies

- ElectAura−Net
by NTT (2003)
- High data rate (10Mbps)
- High Power 2.7W
- Using Electro Optic Probe
- Using 10Mbps baseband signal

10.7MHz crystal oscillator

30mm

30mm   FSK demodulation IC

(a) Transmitter (left) and receiver (right).

(b) The receiver attached to a wrist.

- Intrabody RTX
Funded by Honda
- Low data rate (9600bps)
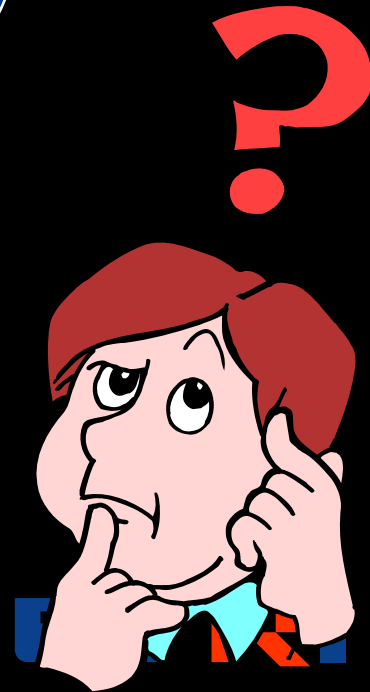- Low power
- Experimented determined optimal frequency 10 MHz

Intrabody RTX
- Funded by Microsoft
- Moderate data rate (38.4 kbps)
- Low power
- Test under various environment
- FSK using 180 and 140 kHz

Wearable Key
- Funded by Sony
- Low data rate (9600bps)
- FSK using 10 and 14Mhz

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RedTacton

GOAL: Perfect a networking technology that transfers data to devices through people's bodies.

WHY IT'S A LOSER: It has no compelling applications that aren't already available, it doesn't work reliably yet, cost is still unknown, and it will likely face perception problems among the general public.

ORGANIZATION: Nippon Telegraph & Telephone Corp.'s Smart Devices Laboratory.

CENTER OF ACTIVITY: Atsugi, Japan.

NUMBER OF PEOPLE ON THE PROJECT: 7.

BUDGET: Not available.

Exactly how the receiver senses these modulations in the electric field generated by the transmitter is one of the major differences between PAN and RedTacton. An electro-optical sensor embedded in the receiver and composed of an electro-optical crystal, a laser diode, and photodetectors reads the body's electric field through an electrode, which then transmits that field to a bismuth silicon oxide optical crystal. The electric field changes the refractive index of the crystal, which in turn changes the polarization of the sensor's laser beam as it shines through the crystal. Photodetectors register polarization changes as changes in light intensity and convert those changes into electrical signals, which are then processed by your cellphone or PDA.

Experiments with a prototype transceiver embedded in a PC Card attached to a PDA have resulted in a two-way 10-Mb/s Ethernet-speed connection that can transmit data in both directions, but not at the same time. NTT is also trying to shrink the RedTacton transceiver down to the size of a compact flash card or smaller so it can be slotted into cellphones, PDAs, and digital cameras. In theory, this would let you upload a spreadsheet from the PDA in your pocket to a friend's smartphone by touching hands.

This year NTT started sharing RedTacton prototypes with "attractive partners," as Kado calls them. They're going to help develop what he hopes will be irresistible products.

These products are likely to be quite costly, at least initially, says Bert Gyselinckx, a researcher specializing in body area networks at the Interuniversity MicroElectronics Center (IMEC), in Leuven, Belgium. He estimates that each of RedTacton's components—the electro-optical crystal, laser, photodetectors, battery, and microprocessor—will be in the US $1 to $5 range.

In addition, the components have to be assembled on printed circuit boards and packaged. Add in some software for error correction and signal modulation, and you have a device that sells for between $50 and $100. That is simply too much money. "If you want to go mainstream, you're going to have to do something for around $10, and that, I think, cannot be done today," Gyselinckx concludes.

But Kado is confident that consumers will pay a premium to get the combination of features RedTacton will provide: speed, security, and lack of interference. Kado suggests that a user could transform into a human Ethernet cable by simultaneously touching a RedTacton-equipped PC and printer to print documents. It's not clear why that would be preferable to using Bluetooth or even a plain old cable. But "simple touch is a more natural and intuitive operation in a computer-based system," Kado argues.

Then there's the holy grail of near-field nobody networks—the exchange of business card information with a handshake. Two people, each with a RedTacton-enabled cellphone, clasp hands and automatically transfer contact information to each other's phones. It would be undeniably appealing, if it actually worked. Unfortunately, it doesn't, at the moment. A year ago, the RedTacton research team reported in IEEE Transactions on Instrumentation and Measurement that its test of handshake intrabody communication

"was unstable, and almost every packet was destroyed in the worst case.... It is thought that the electric coupling between two persons varied because of their movement." Alternatively, those communicating could stand still as statues in hopes of achieving a satisfying electric coupling.

Though the handshake exchange certainly has a way to go, Kado says his team is developing a dynamic transmitter that compensates for parasitic capacitances produced by bodies as they move.

Maybe a killer app lurks in the health-care sector? Kado points out that RedTacton medicine bottles could sound an alarm when you're taking a pill at the wrong time. That could be good for the elderly, but how many seniors will flock to an unproven technology, especially one that they might think would endanger them?

"Although [it is] unsubstantiated, the RedTacton technology can be a potential risk for people with medical problems," says Benny Bing, associate director of the Georgia Tech Broadband Institute, in Atlanta. "Electric field signals traveling though the body—no matter how small these signals are—may trigger a heart attack or a stroke." He points out that some people still have a phobia about holding cellphones close to their heads, despite plenty of studies that show there is very little to worry about. Without the facts, this phobic reaction "may just be psychological, but it will prevent people from using the technology," Bing adds.

Surely there's an application compelling enough to induce people to throw their inhibitions out the window and their credit cards on the counter. Kado thinks it might be the ad hoc creation of peer-to-peer networks of personal music and video players, allowing people to touch hands to share photos, videos, and songs.

Of course, there are some pesky copyright-protection issues that would have to be dealt with, not to mention interference and security problems. Though RedTacton users would not suffer the same interference issues that occasionally vex Bluetooth and Wi-Fi users, RedTacton users packed closely together could interfere with each other, as researchers from NTT and NTT DoCoMo Inc. reported in a paper delivered in Tokyo last September, at the Seventh International Conference on Ubiquitous Computing.

And even though RedTacton signals can't be snooped from a distance, what's to stop people with bad intentions from bumping into you on the street to transfer a computer virus or maybe even steal your identity?

Some NTT customers might well brush aside security and health concerns and buy RedTacton devices. After all, Japan is home to some rather intimate electrotechnologies, including Matsushita Electric Industrial Co.'s DL-MS1 toilet seat, which measures body fat by sending a mild electric charge through the user's buttocks.

But "in all likelihood [the NTT team] will find it extremely hard to marshal enough momentum and win over people's hearts," says Chatschik Bisdikian, coauthor of Bluetooth Revealed: The Insider's Guide to an Open Specification for Global Wireless Communications. "And they will need to, because people themselves need to be an integral part of the communications loop with these technologies." ∎

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Is the wireless communication perfect?

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Wireless Communication

- **Bluetooth Photo Printing requires user to do the following things**
  - **Scan**
  - **Connect**
  - **File Select**
  - **Print**
  - **Disconnect**
- **With simple input interface of portable device, this can be the tough job.**
- **User have to learn.**

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Bluetooth Presetting cannot solve the problem

?

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Ubiquitous Computing

- The number of device waiting to serve in a given space is increasing as the ubiquitous computing of future arise.

- The user have to learn a lot more.
  – This can be problem
  – Currently there is 18 ways for printing a picture with camera and printer.

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Why?

Why a lot of user manipulation and learning is required?

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Context

- **Definition**
  - **any information that can be used to characterize the circumstances of an entity, which can be a person, a place, or an object that is considered relevant to the interaction between a user and an application including the user himself/herself and the applications themselves**

Context in this situation

- Identity of the user, i.e., authorization of the user to use the printer

- Selection of devices, e.g., printer and PDA

- Selection of the service, i.e., printing

- Data of interest, i.e., specific photo file to be printed

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Redemption
Context Awareness Computing

- **The applications do the right thing at the right time for users without their direct manipulation**

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How can the computer know what does user want?

- Key Question in Ubiquitous Computing

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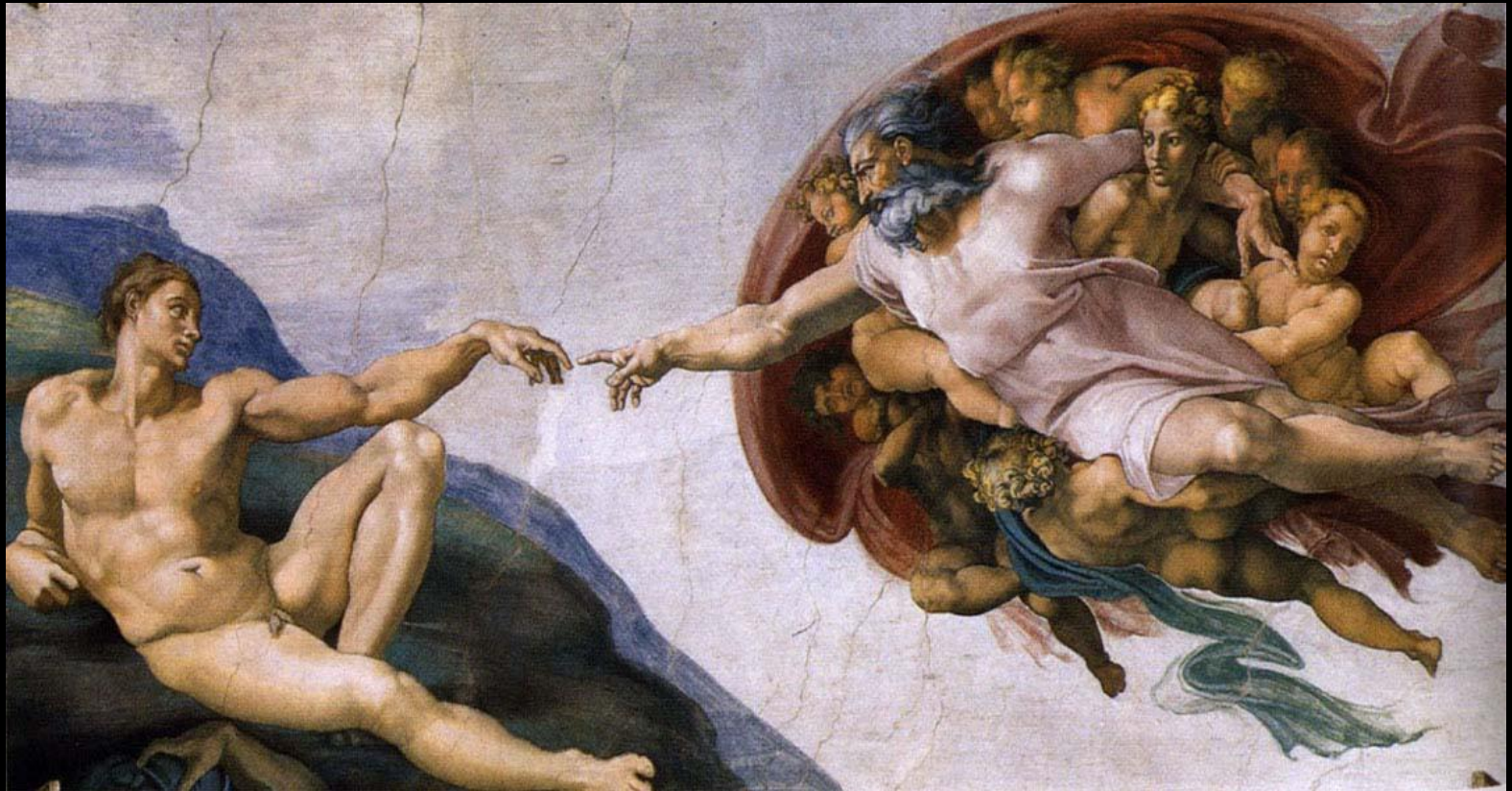
Touch

Touch?

- **Uncomfortable**
  - **We invented Remote Controller to avoid it.**

- **Intuitive**
  - **Touching is familiar sign of interest.**
  - **Touching can provide Context.**
    - **Lots of paper including CHI2006**

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Touch in previous studies

SyncTap: Rekimoto et al.

Key Idea

- The user can print the photo he was seeing in the camera by just touching the printer while holding the camera.

- Touch and Play (TAP)

Demo

Ubiquitous World with Bluetooth

- **TASK: Print the pictures with mobile phone and printer**

Seq	Action	Time
1	Scan	5
2	Connect	2
3	Select	3
5	Print	2
4	Disconnect	1

Ubiquitous World with TAP

- **TASK: Print the pictures with mobile phone and printer**

Seq	Action	Time
1	Select	3
2	Touch	2

Does not count in the cognitive
View point of user

Intuitiveness
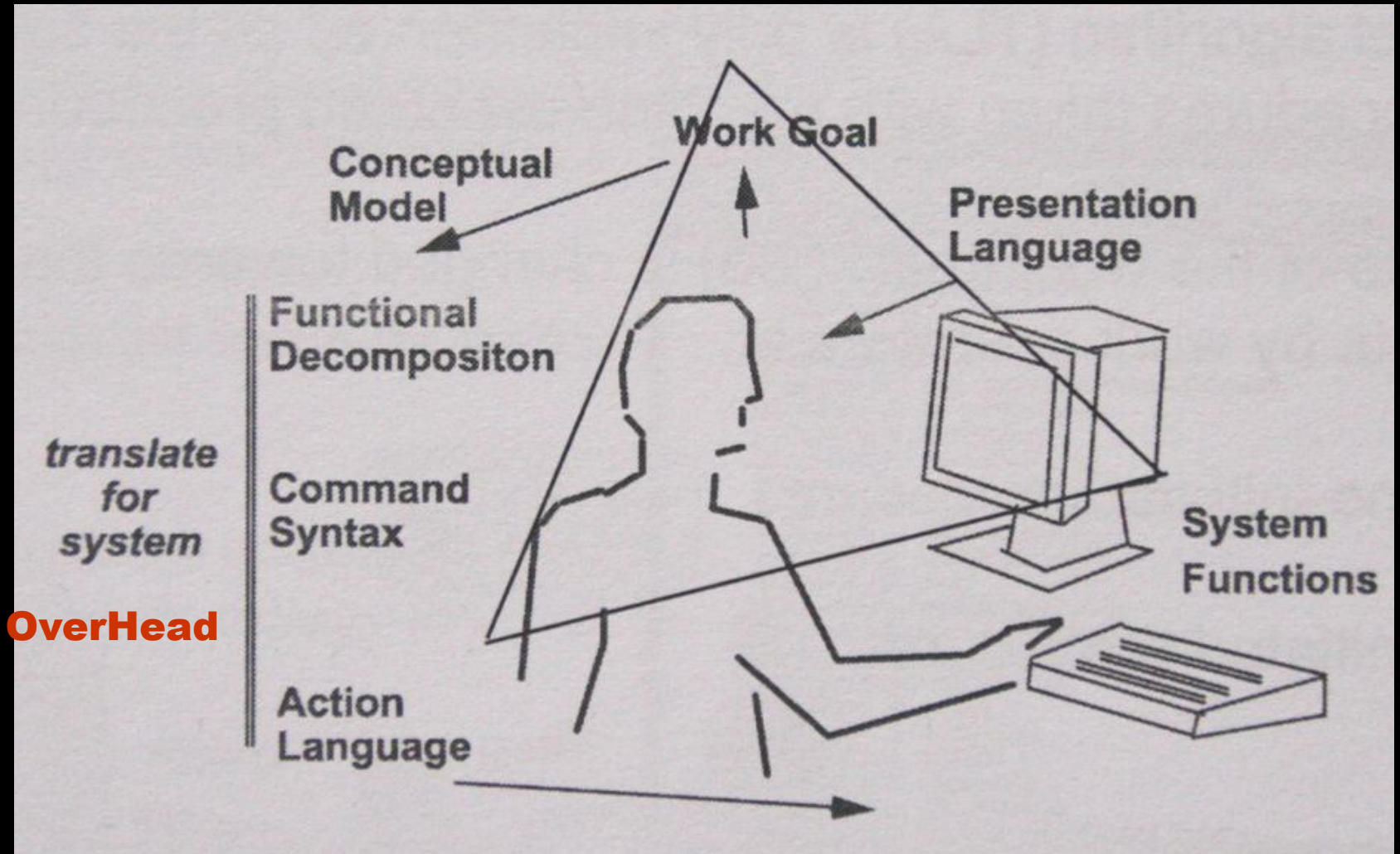
Conceptual Model

- **Bluetooth**
  - **Transfer the data from one device to another device using wireless communication network**

- **TAP**
  - **Evoke most likely service by touching**

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Functional Decomposition

- **Bluetooth**
  - **Scan**
  - **Select**
  - **Connect**
  - **Select Data**
  - **Select Service**
  - **Disconnect**

- **TAP**
  - **Select Data**
  - **Find the most likeable Device**
  - **Evoke**

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Command Syntax

- **Bluetooth**
  - **Has to be learned**

- **TAP**
  - **Select Data -> Usually already done**
  - **Find the most likeably device -> very easy to learn**
  - **Evoke the service -> very easy to learn**

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Action Language

- **Bluetooth**
  - **Lots of key typing**

- **TAP**
  - **Touch -> Always Same!**

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Context Aware Matrix

	PC	TV	Printer	Camera	Mobile phone	MP3 Audio
PC	Network Connection	Monitor Connection	Printer Connection	Camera Connection	Sync Connection	Network Connection
TV	Monitor Connection		Print TV schedule	Slide Show	User Identification	Play MP3 music
Printer	Printer Connection	Print TV schedule		Print Photo	Print phonebook	Print Album title
Camera	Camera Connection	Slide Show	Print Photo		Set as wall paper	
Mobile phone	Sync Connection	User Identification	Print phonebook	Set as wallpaper	Exchange Name card	Set As Ring Sound
MP3 Audio	Network Connection	Play MP3 on TV	Print Album title		Set as ring sound	Playlist Sync

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Expandability

- **Interaction between TV & TV?**

Sync Channel

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Discussion

Context Automation Level

- **High: Provide all service (group A and group B).**
- **Normal: Provide any good enough service (group A only).**
- **Low: Provide the service approved by the user.**
- **None: Do not provide any service.**

Intentional vs Unintentional Touch

- Confirmation Process
- Disabling TAP when device is in sleep mode
- TAP button or area

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Multi-function Convergence Device

Camera
Mobile Phone
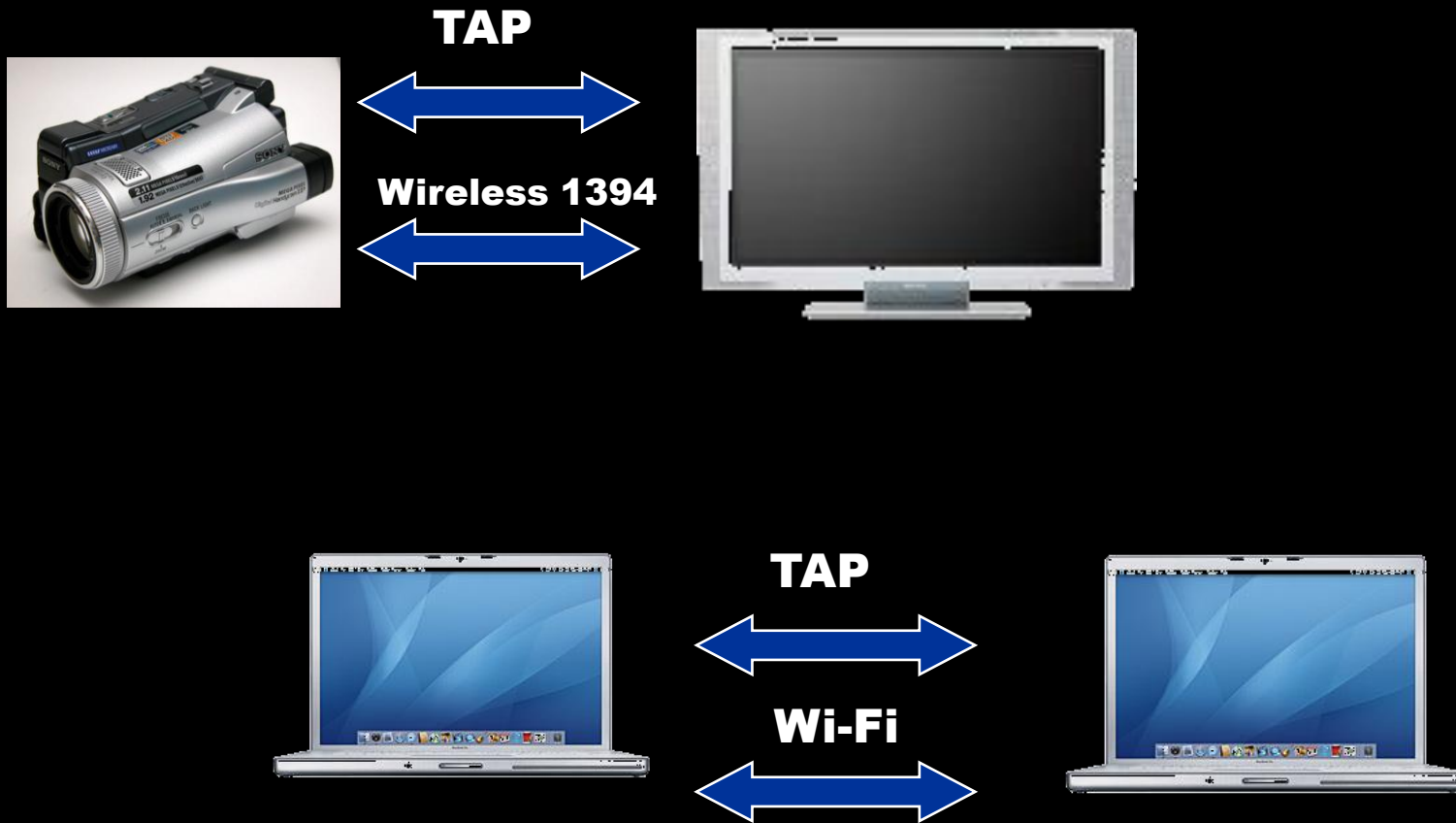**MP3**
PDA

Printer
Scanner
FAX
Photocopier

※ 프린터는 별매 입니다.

- ## Dynamic Function ID allocation

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Coexistence with other method

TAP

Wireless 1394

TAP

Wi-Fi

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Metcalfe's Law

- **The usefulness, or utility, of a network equals the square of the number of node**

  - Usefulness = (Numeber of Node) ^{2}

- **TAP can be implemented cheaply.**

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Physical Layer Independent

- **UWB with narrow range (10cm)**
- **NFC by Nokia**
- **Other Intrabody Communication including NTT Redtaction**

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Conclusion

- **The intra-body signaling method can be useful in the ubiquitous computing future.**

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Future work

- ## User Evaluation
  - ### Working Prototype

- ## Context matrix refinement
  - ### Importance, intuitiveness, usefulness

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TAP from Future?

Estimated UFO Artifact from Roswell

Thank you!
Welcome Question!

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