



EPFL workshop

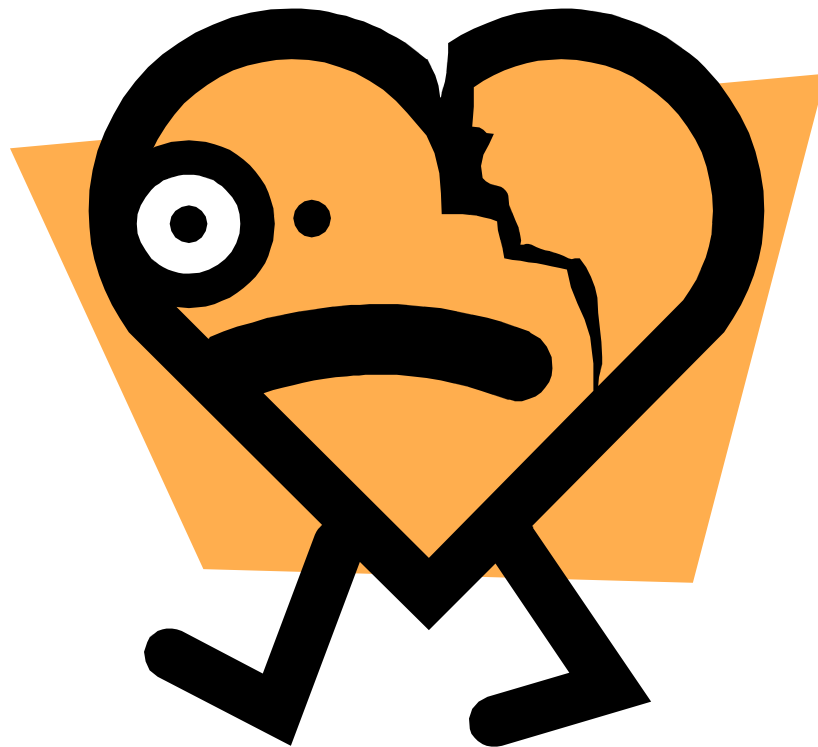
Ambient SoC Initiative

December 17, 2009

Satoshi Goto
goto@waseda.jp

Waseda University, Japan

- Why EECS is not loved by students ?



EECS is called 3K job (Japan) 3D?

Kitsui : Hardwork



Kaerenai : Cannot come back to home early



Kyuryou ga yasui : **L**ow **S**alary

3D:
Dangerous
Dirty
Demeaning



People's dream to buy (1/2)

Japan

(1960)



Black & white TV



Washing Machine



Refrigerator

(1970)

3C



Color TV



Cooler



Car

People's Dream to buy (2/2)

Japan

(2003)



Digital Camera



DVD decoder



LCD/PDP TV

(2005)
3P



PC



Mobile Phone



Play Station

What is next ?

Japan

Surveyed by Goo, 2008

(1) LCD TV



(2) Note PC



(3) DVD Decoder



(4) Desk Top PC



(5) Digital Camera



(6) Washing Machine



(7) Refrigerator



(8) Game Computer



(9) Mobile Phone



(10) iPod



What is next ?

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(8) Game Computer



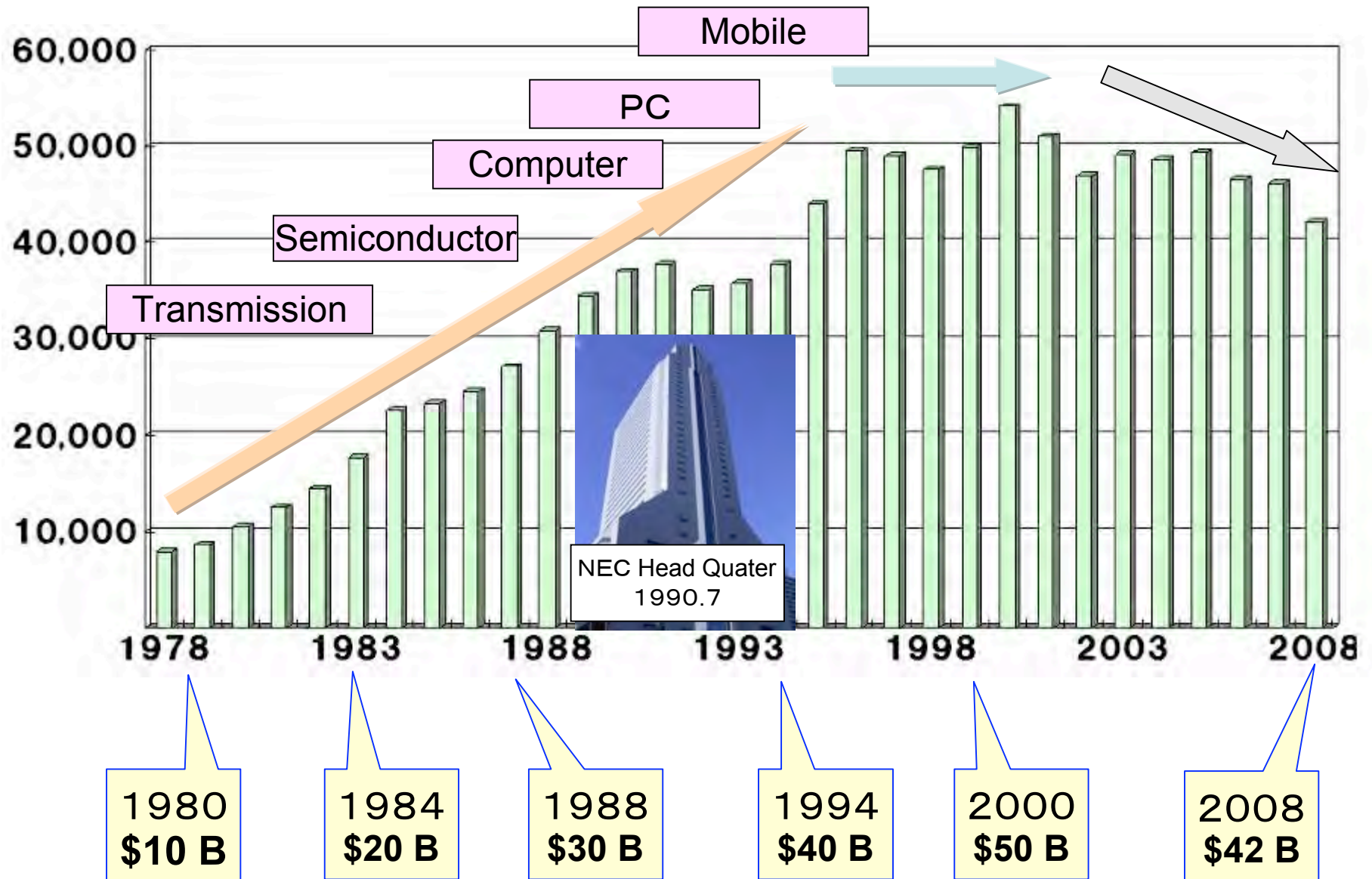
(9) Mobile Phone



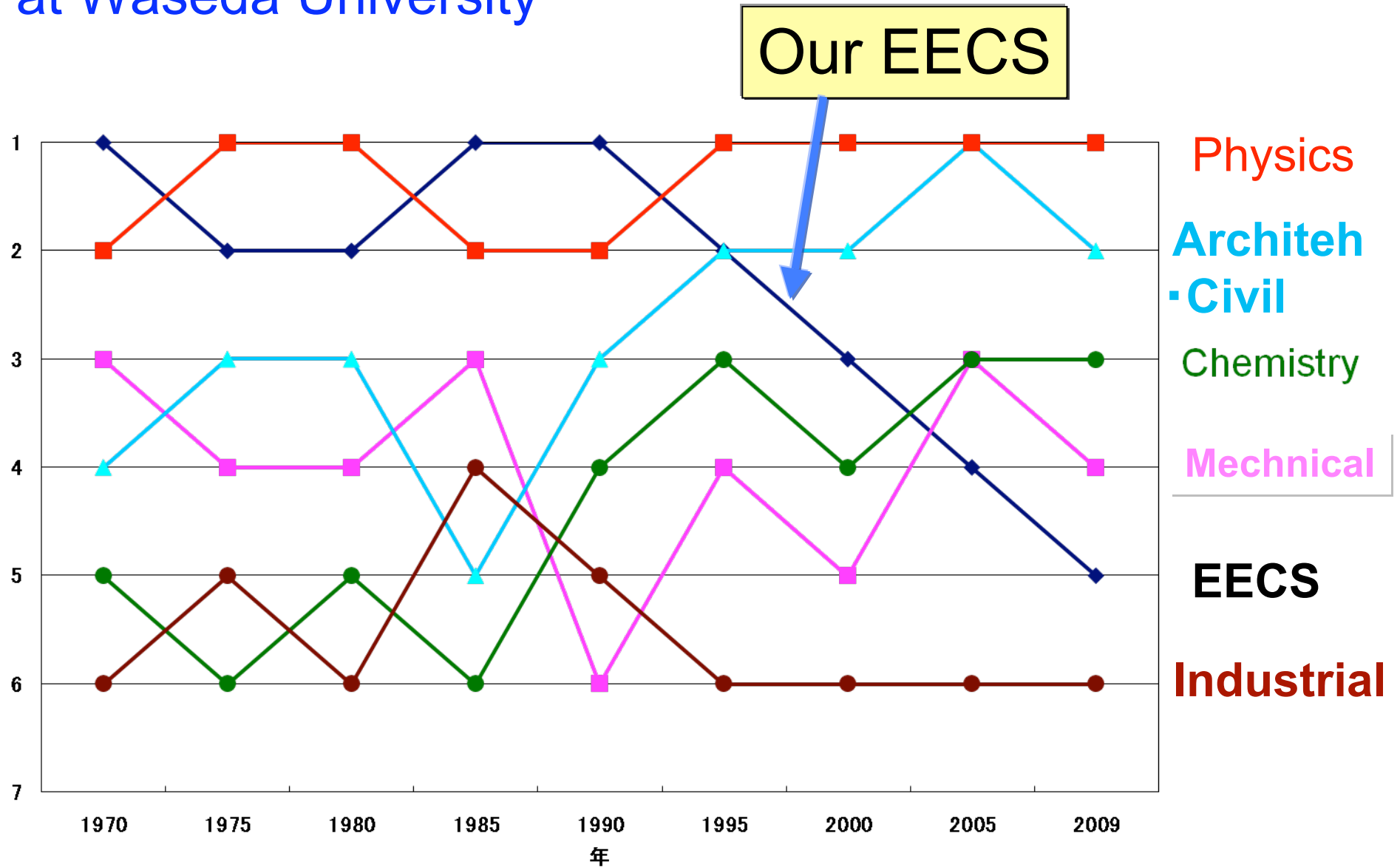
(10) iPod



NEC Amount of Sales



Entrance Examination Rank of School of Engineering at Waseda University



Department of Engineering at University of Tokyo

1999		2006		2009	
航空宇宙	81.9	機械B (機械、ロボ-1系)	81.1	物理工学	77.9
建築	80.2	物理工学	78.8	機械B (機械、ロボ-10系)	77.0
機械B (建築、ロボ-1系)	79.0	航空宇宙	78.6	都市計画	73.8
都市計画	78.4	応用科学	77.1	建築	73.5
Computer Science		化学生命	76.6	航空宇宙	73.2
化学生命	76.1	建築	75.7	化学生命	72.1
化学システム	75.8	化学システム	72.3	応用科学	71.6
社会基盤 (計・土)	72.7	計数工学	71.8	計数工学	71.4
物理工学	72.5	都市計画	70.5	精密	68.4
Electric Engineering		社会基盤 (計・土)	69.9	社会基盤 (計・土)	65.8
都市環境	70.8	機械A (設計、電装系)	69.7	システム創生 (計・船舶、原子力、計測)	61.8
機械A (設計、電装系)	70.7	Computer Science		マテリアル (計・材料、金属)	61.4
計数工学	69.9	都市環境	66.9	都市環境	61.1
応用科学	67.6	システム創生 (計・船舶、原子力、計測)	63.9	Computer Science	
精密	65.6	マテリアル (計・材料、金属)	62.5	化学システム	56.3
マテリアル (計・材料、金属)	58.0	精密	62.4	Electric Engineering	
システム創生 (計・船舶、原子力、計測)	56.4	Electric Engineering		機械A (設計、電装系)	52.6

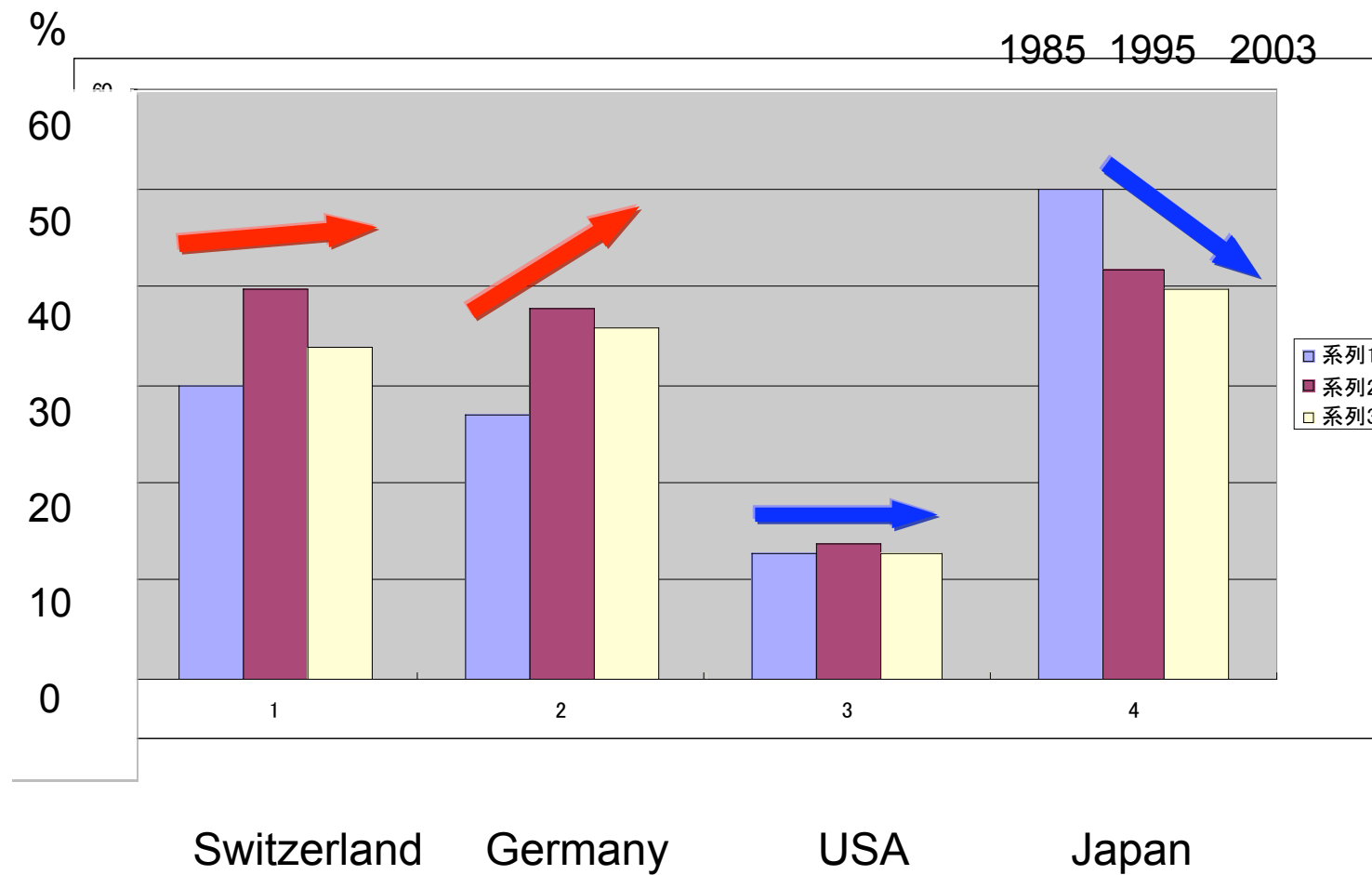
Change the name of EECS

EECS



- Information Science
- System Science
- Information & Communication
Technology
- IT
- Bio & EE
- Optical EE
- Media & Intelligence

Percentage of Graduate Degree in Science and Engineering among all degrees



Which company students want to work in Japan ?

	1	2	3	4	5	6	7	8	9	10
1980	Hitachi	NEC	Fujitsu	IBM	Toshiba	Toyota	Nissan	Panasonic	Sony	Kajima
1985	NEC	Hitachi	Fujitsu	IBM	Toshiba	Sony	Toyota	Panasonic	Shimizu	Taisei
1990	Sony	NEC	NTT	Toshiba	Panasonic	Hitachi	IBM	Fujitsu	Mitsubishi	JR
1995	Hitachi	NTT	Mitsubishi	NEC	Sony	Toshiba	Ishihari	Kawasaki	Panasonic	Toden
2000	Sony	NTT	Honda	Docomo	Toyota	NTT Data	NEC	Panasonic	IBM	Suntory
2005	Toyota	Suntory	Hitachi	Shiseido	Honda	Panasonic	Fujitsu	Sony	kagome	Asahi
2009	Sony	Toyota	Google	Nintendo	Panasonic	ANA	NTT	Honda	Shiseido	Docomo

Which business division does a freshman want to enter ?



Super Computer

Personal Computer



Satellite System



Mobile Phone

Which business sector does a freshmen want to enter ?

②



Super Computer

④

Personal Computer

①



Satellite System

③



Mobile Phone

Fresh men want to enter Non-profitable Divisions or Laboratories



Super Computer
\$ 300 Million /year
0.6% sale



Personal Computer
\$ 8,000 Million /year
16% sale



Satellite System
\$ 500 Million /year
1.0% sale



Mobile Phone
\$ 10,000 Million/Year
25% sale

Which makes money ?



TV sets

Broadcasting system

Which makes money ?



TV sets

15

:

$\$ 500 \times 30,000,000 \text{ unit}$
 $= \$ 15,000,000,000$

Broadcasting system

1

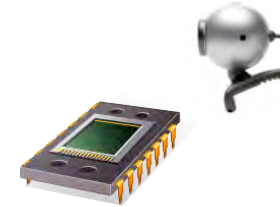
$\$ 100,000,000 \times 10 \text{ unit}$
 $= \$ 1,000,000,000$

Sony, Panasonic

Hitachi Toshiba

NEC, Fujitsu

Volume and Market



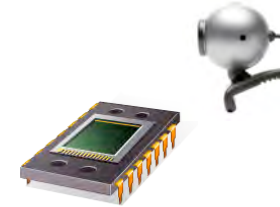
Organization

Office

Person

Object

Volume and Market



Organization

1
x \$100000

Office

100
x \$1000
= \$100,000

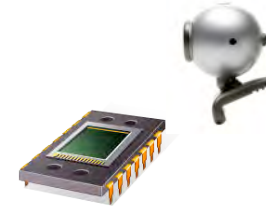
Person

1000
x \$100

Object

100000
x\$1

Volume and Market



Profitable market

Research &
Development

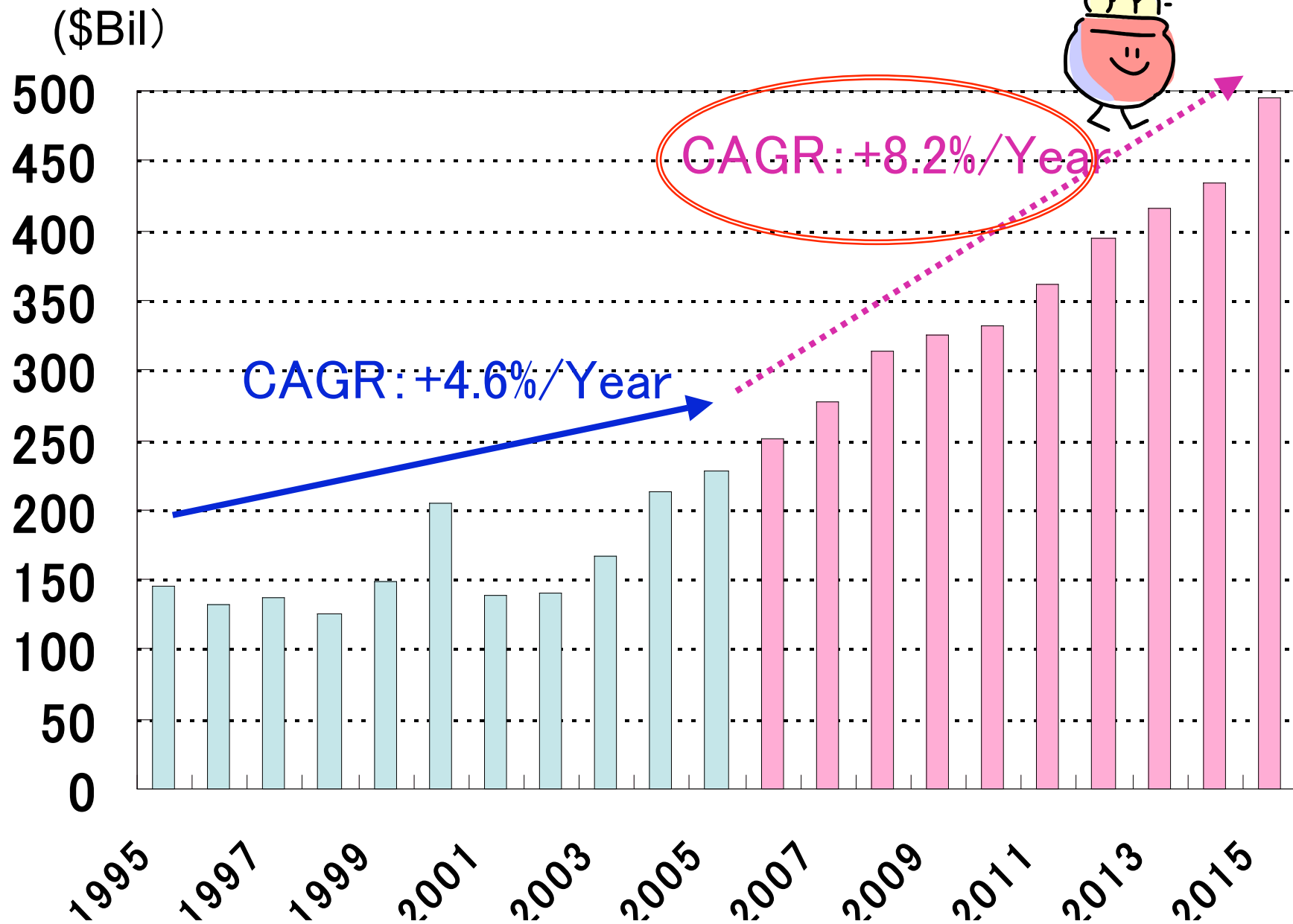
Electronics Engineer feels

- Our daily life is already surrounded by many electronic appliances and no attractive things to buy.
- New technology are created from other fields (Robot, Biology, Media), not from EE.
- No emerging technologies are born from EE.
- EE become too wide, deep and complicated and very hard to understand all of them.
- Not easy to be professional in EE.

What electronics give a dream to young people ?

Is there any future for electronics ?

Prediction of Semi-conductor Market



Ubiquitous Society

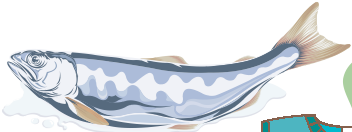
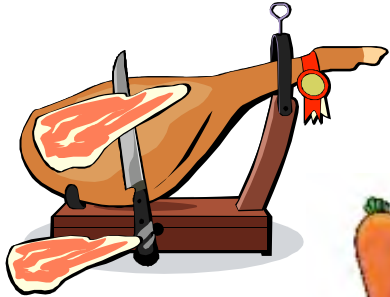
LSI is embedded in every electronic equipment



We will have 1,000 LSIs in our surrounding for better life.

Our human daily life

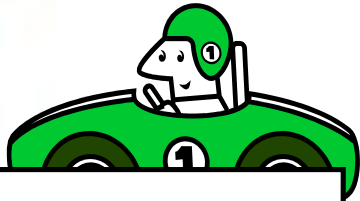
Eating



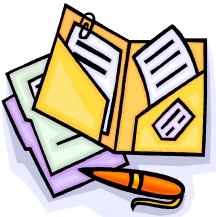
Entertainment



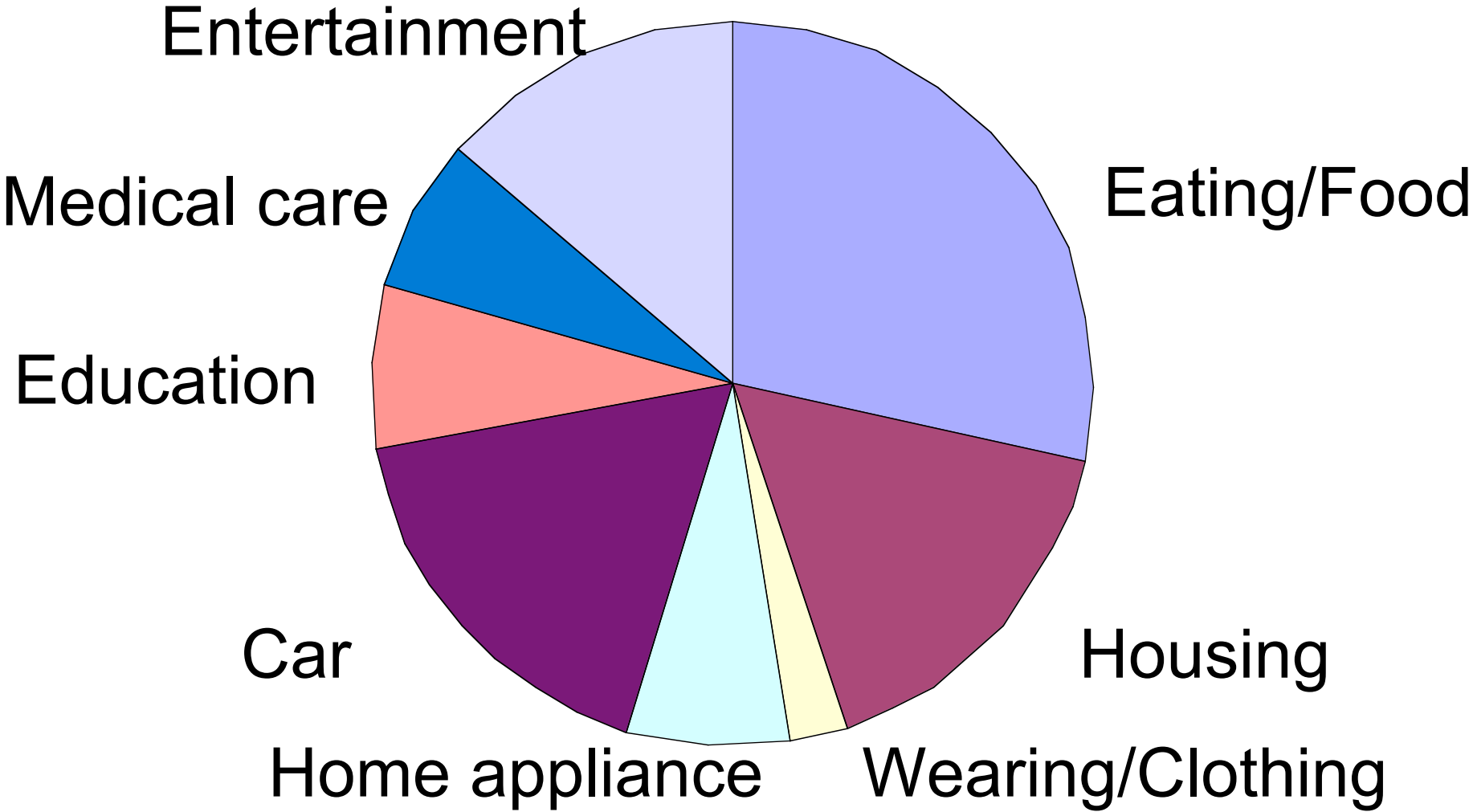
Housing



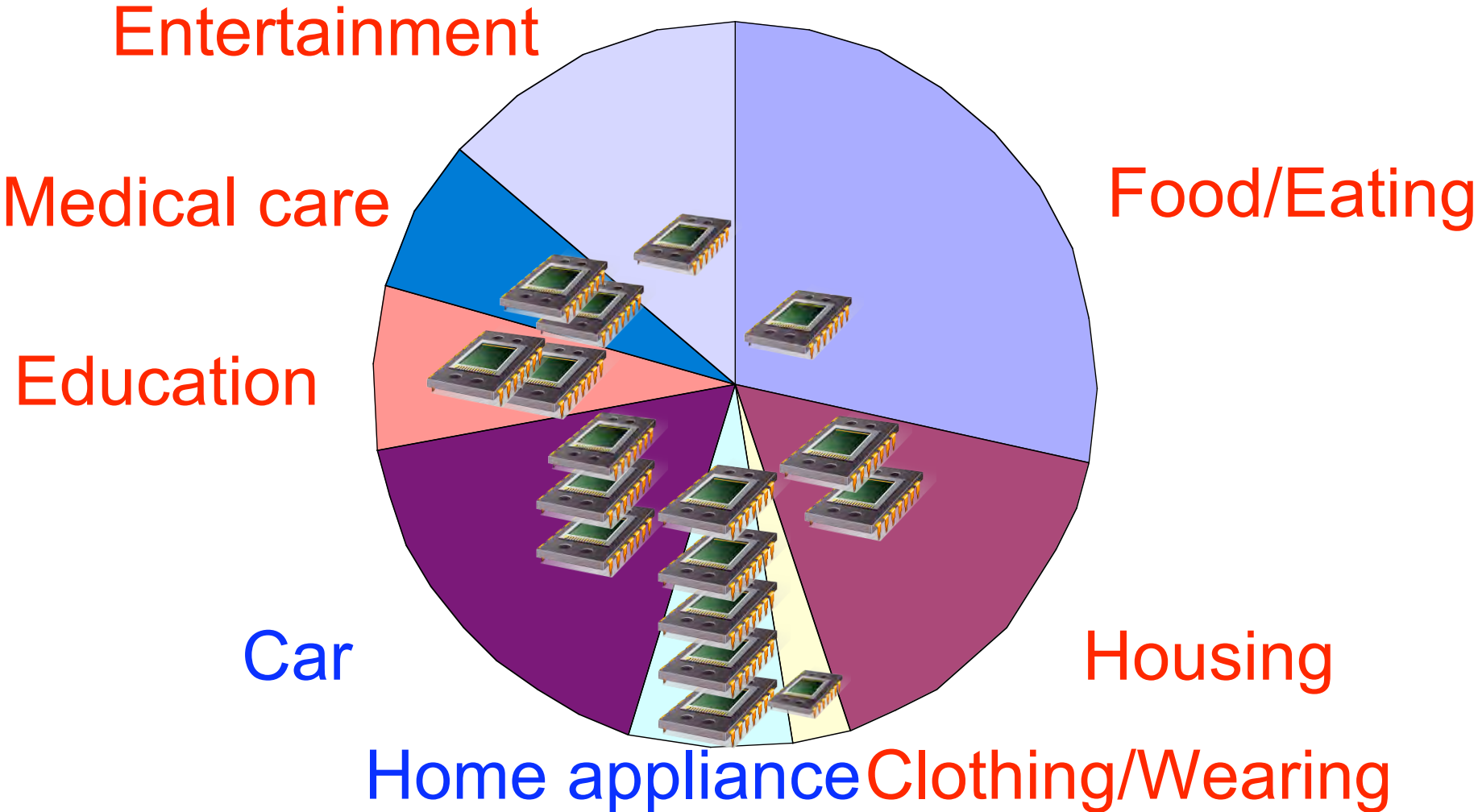
Wearing



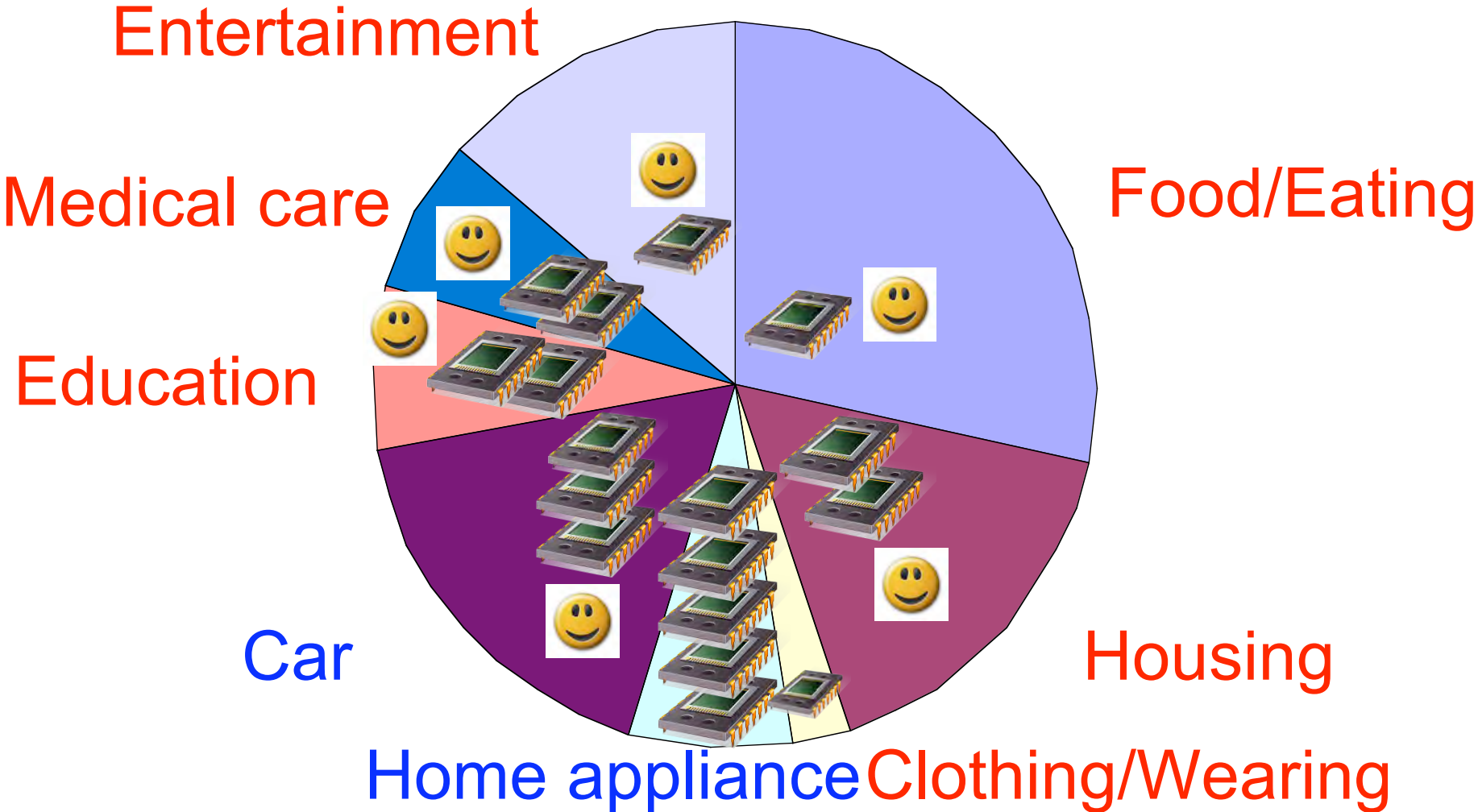
Expenditure of a family



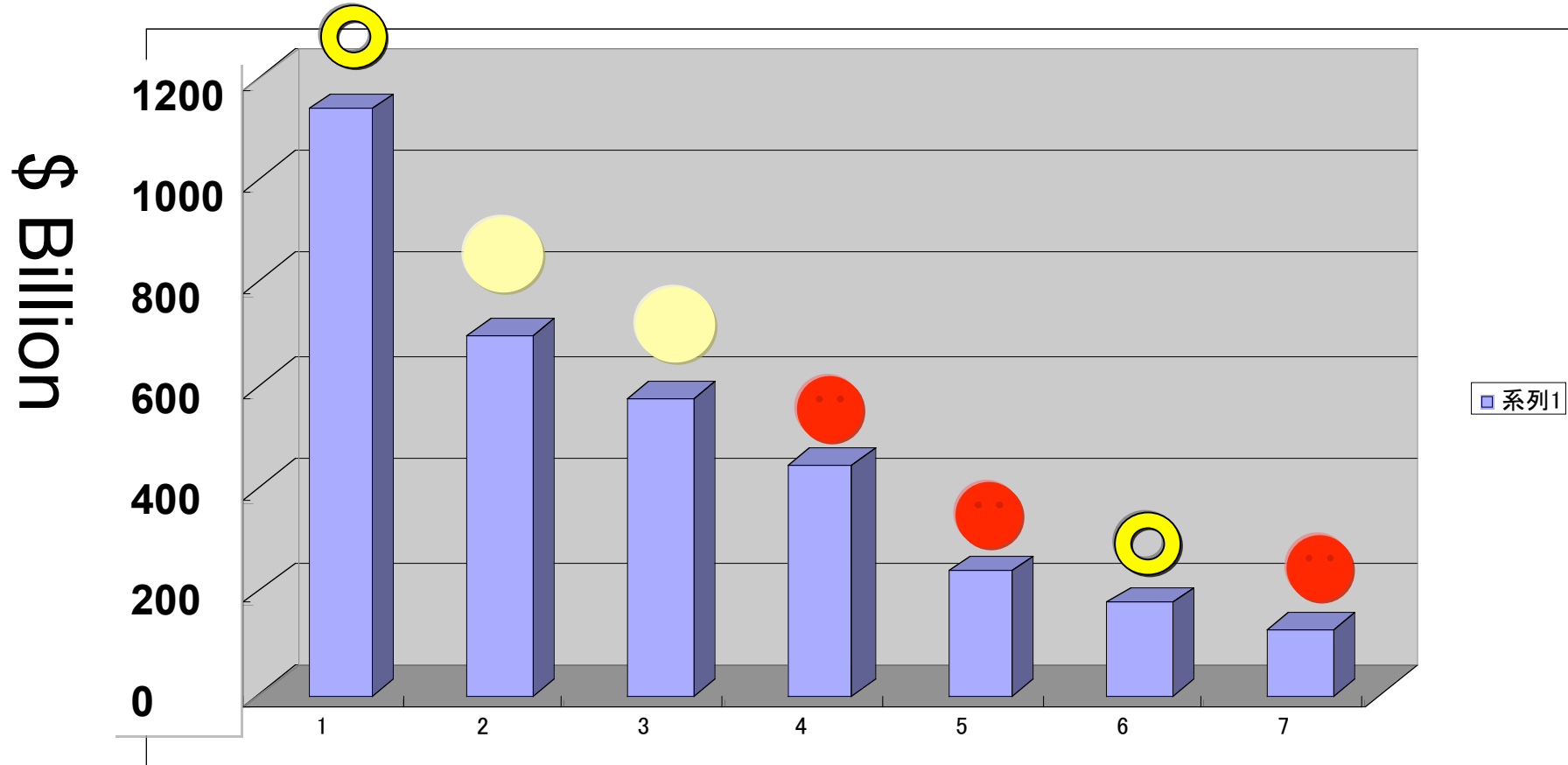
How much electronics is inside ?



How much electronics is inside ?



Amount of sales in Japan



Electric & Electronics **Automobile** **Construction** **IT & Communication**
Material **Food** **Medicine**

LSI in Future embedded in our life



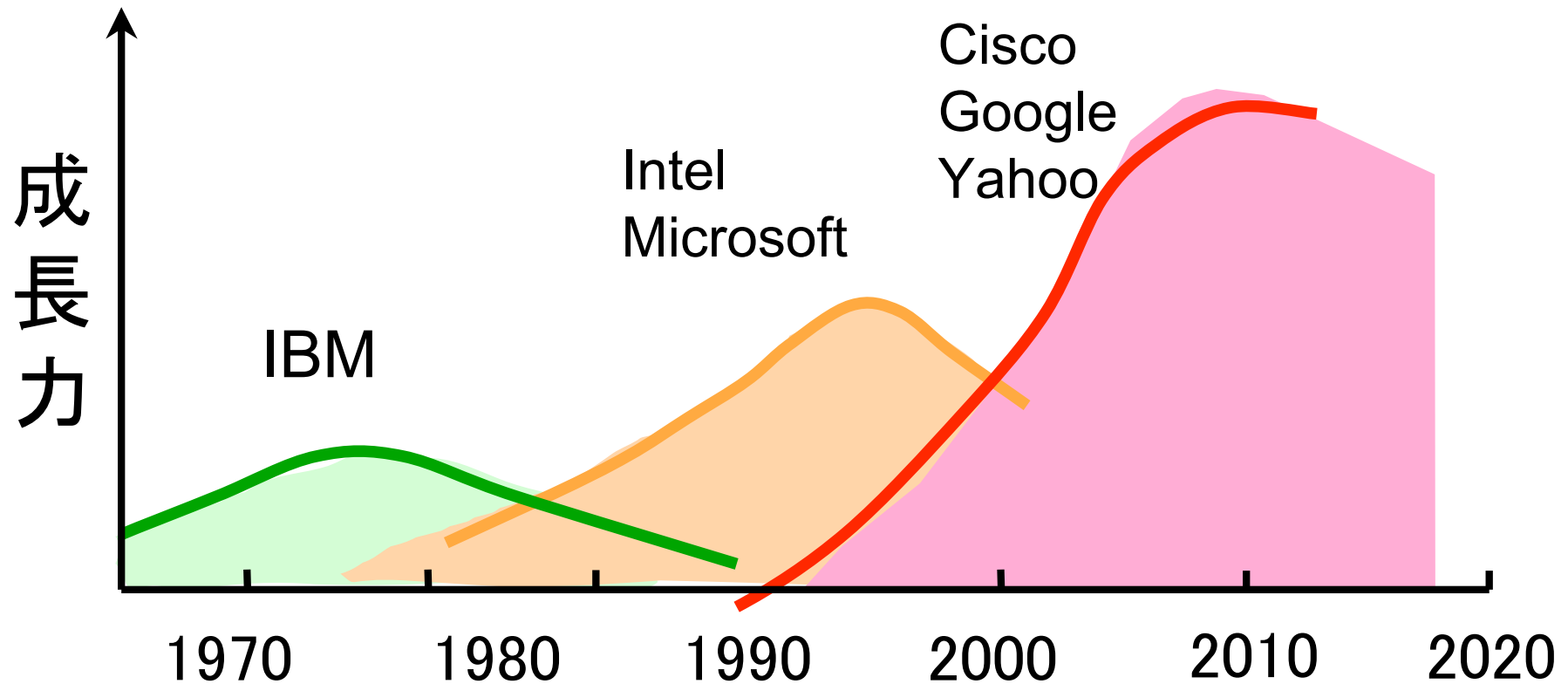
We will have 10,000 LSIs in our surrounding for secure and comfortable life

History of IT

1st Wave
(Main Frame)

2nd Wave
(PC)

3rd Wave
(Internet)



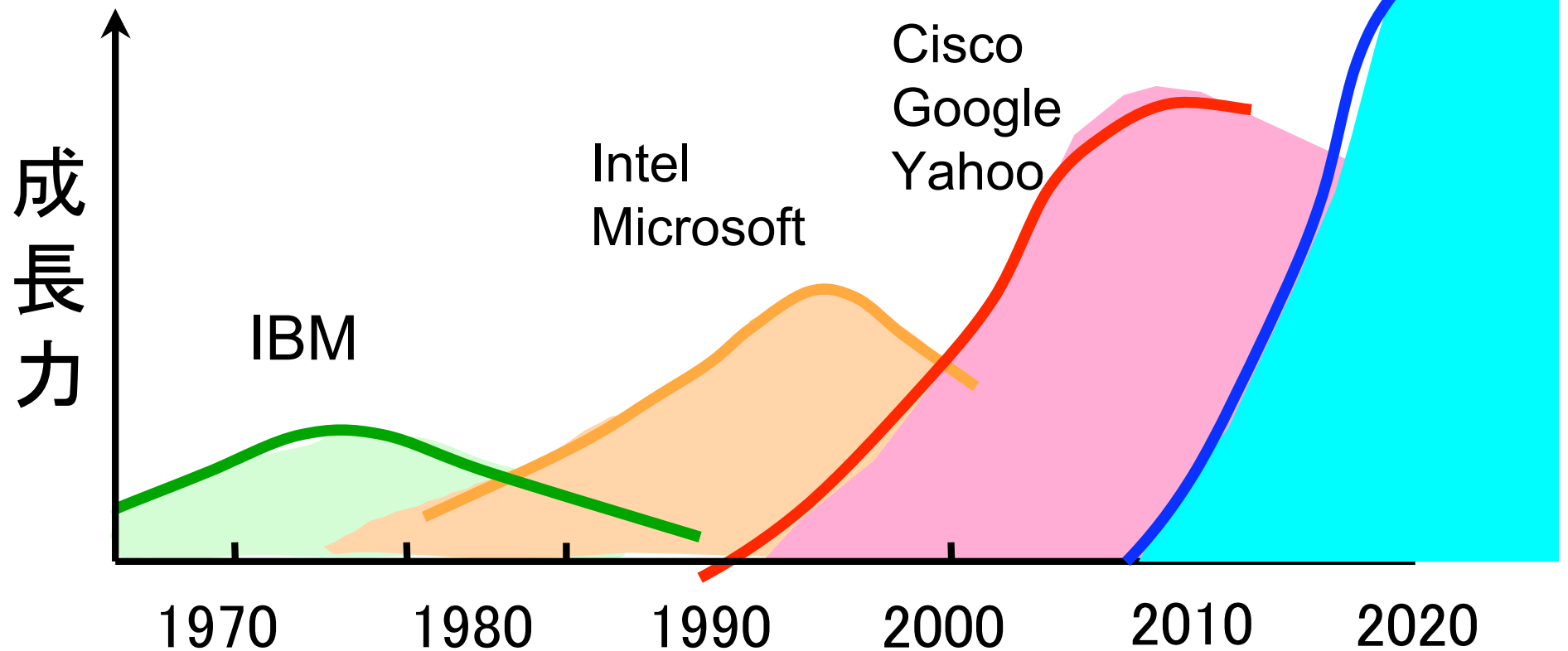
History of IT

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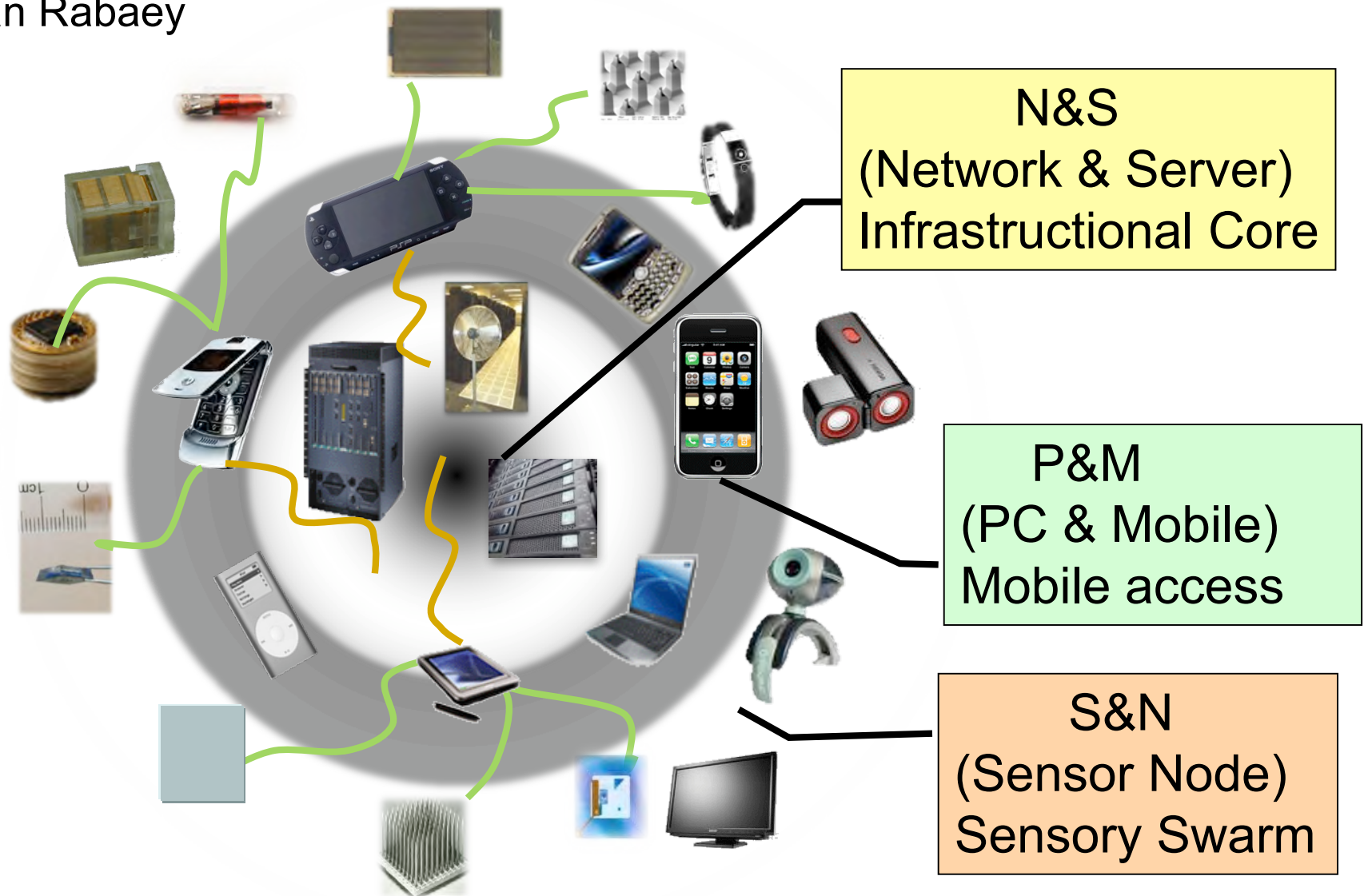
4th Wave
(Connection)



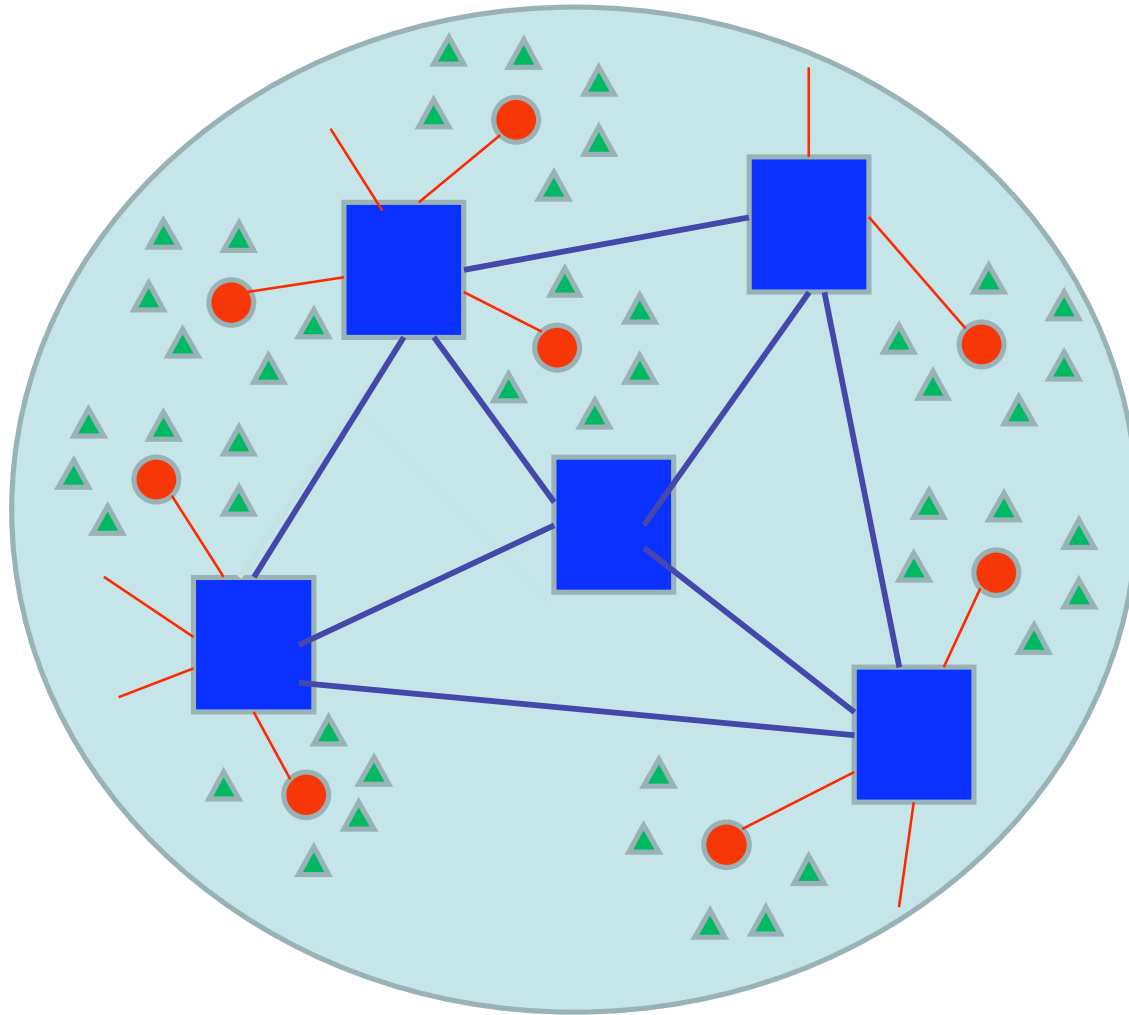
What is the IT future ?

The Emerging IT Scene: 3 layers

By Jan Rabaey



3 Layer IT structure



N&S
(Network & Server)



P&M
(PC & Mobile)



S&N
(Sensor & Node)

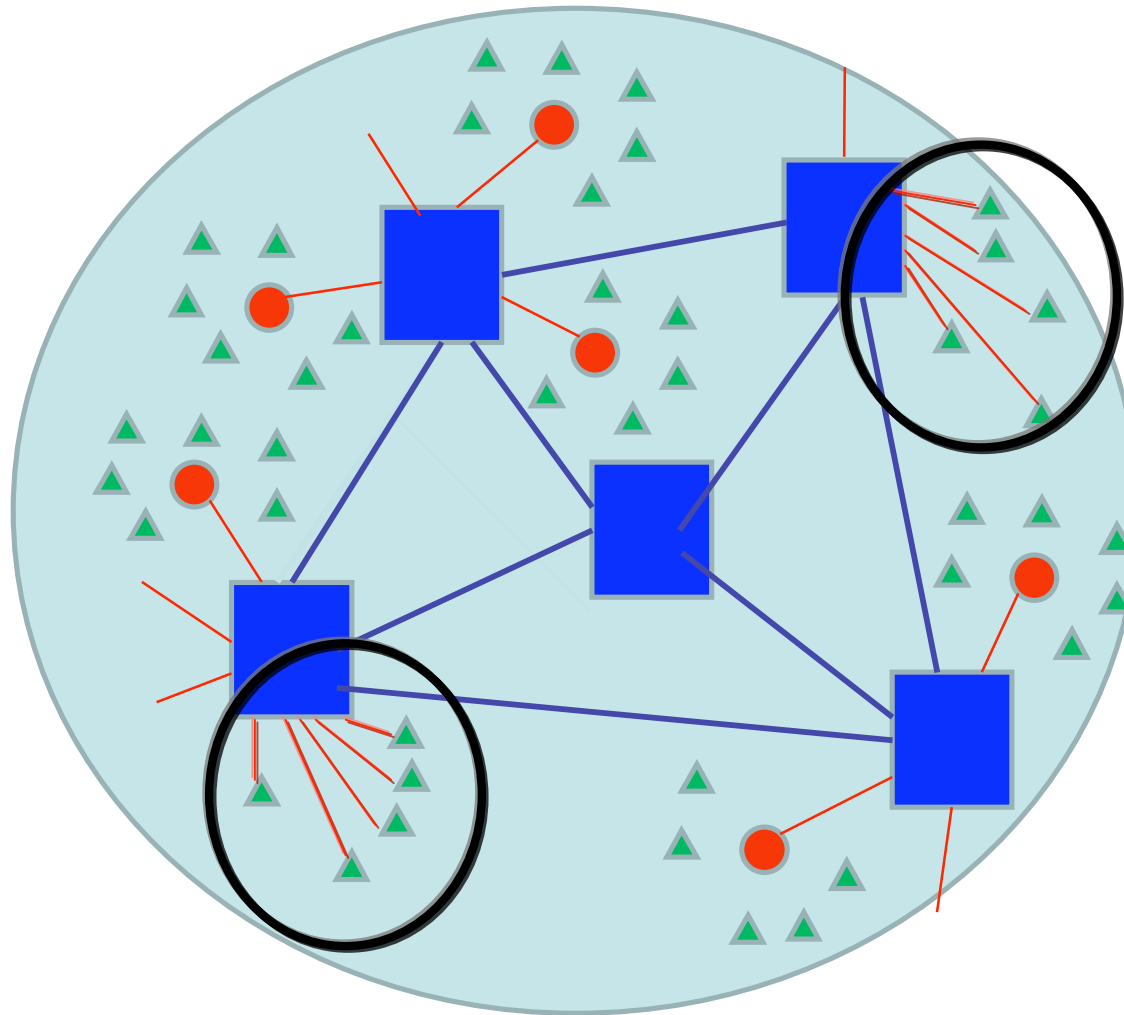
2 Layer IT structure



N&S



S&N



2 layer is possible
as long as
Ultra High
Communication Speed
is guaranteed

3 layer IT structure

Core Tech.	N&S	P&T	S&N
High Speed Large Memory High Reliability	○	○	
Intelligence	○	○	
Usability		○	
Low Power	○	○	○
Functionality			○

3 layer IT structure

Core Tech.	N&S	P&T	S&N
High Speed Large Memory High Reliability	●	○	
Intelligence	●	●	
Usability		●	
Low Power	○	○	●
Functionality			●

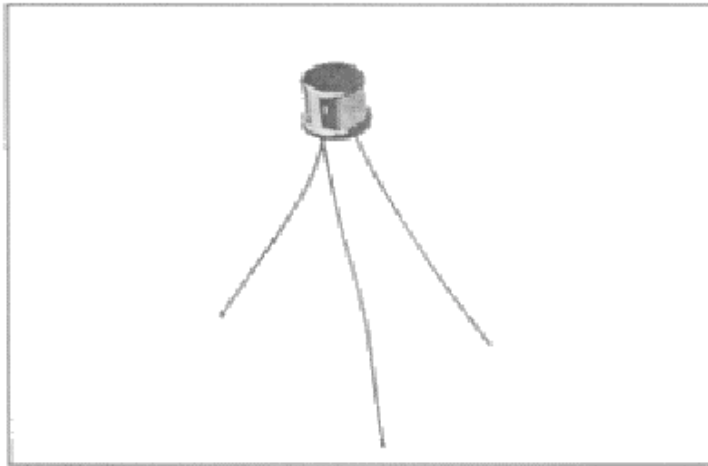
“I think
there is a world
market for maybe
five computers.”



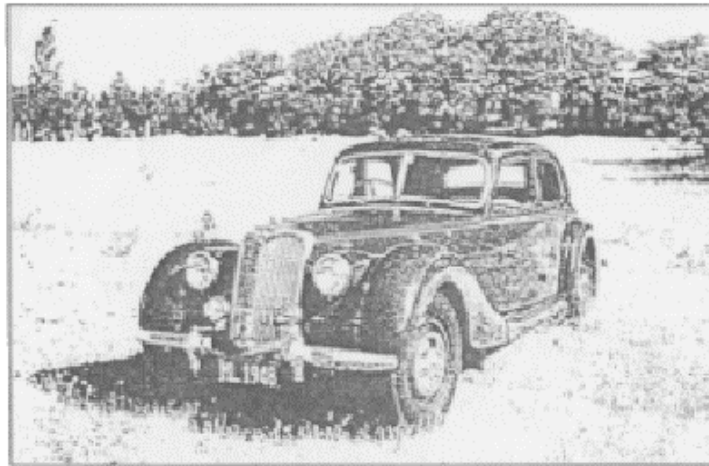
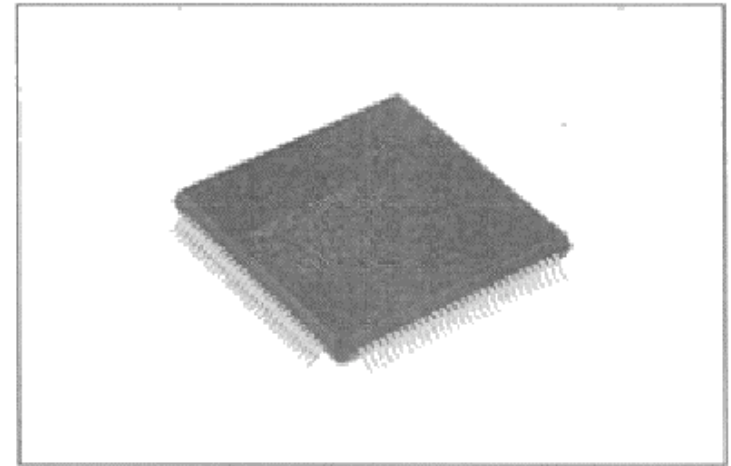
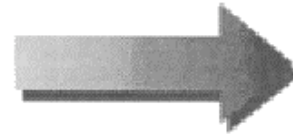
Photo: IBM Corporate Archives CC BY-SA

➡ Cloud Computer

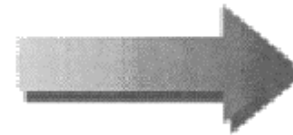
Evolution of Semiconductor



35 years

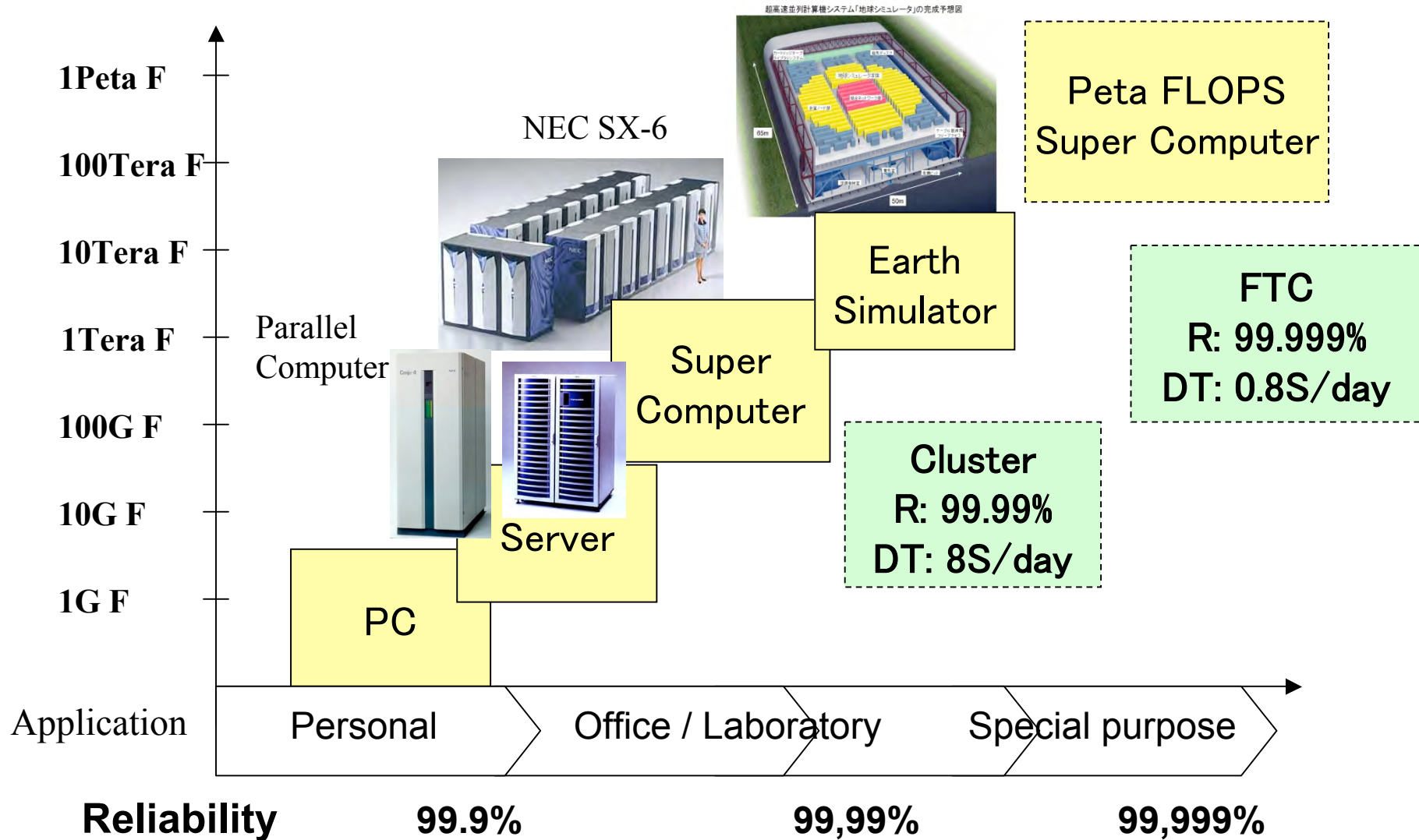


35 years

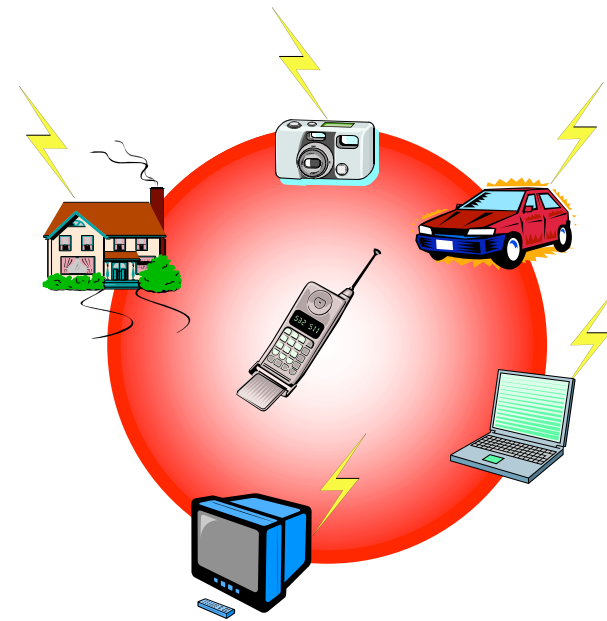
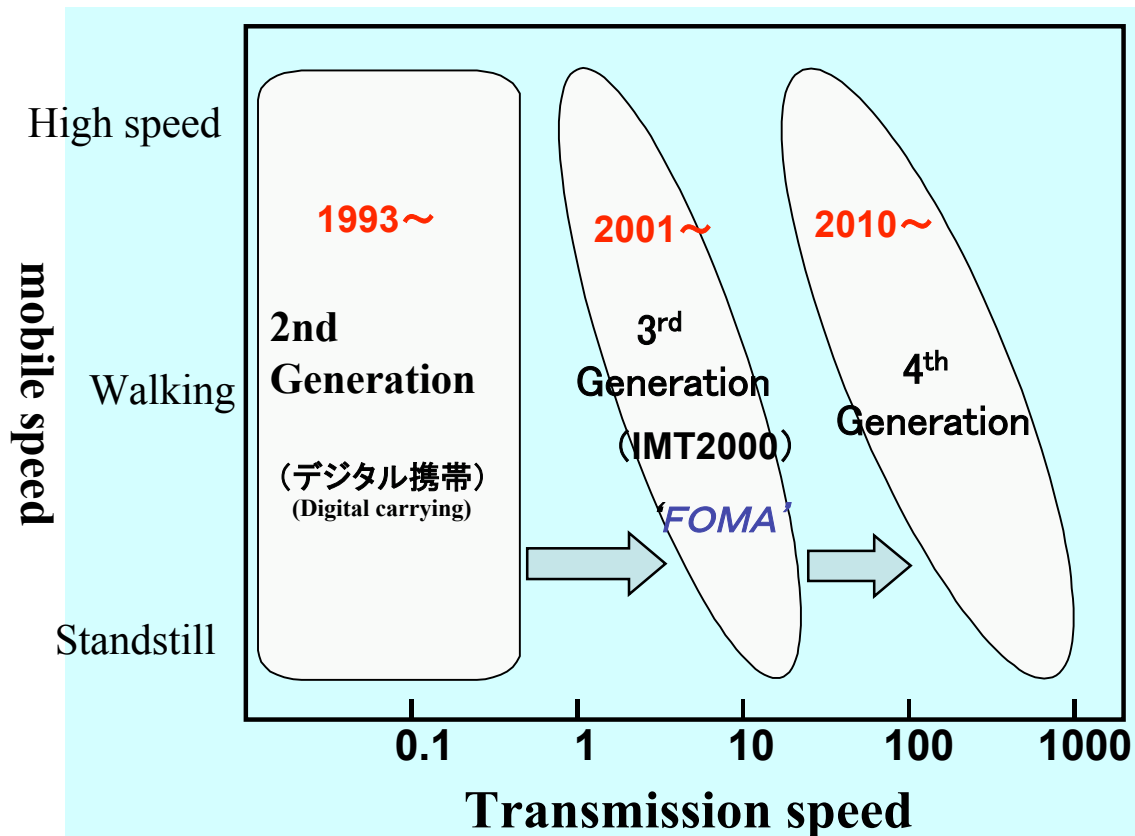
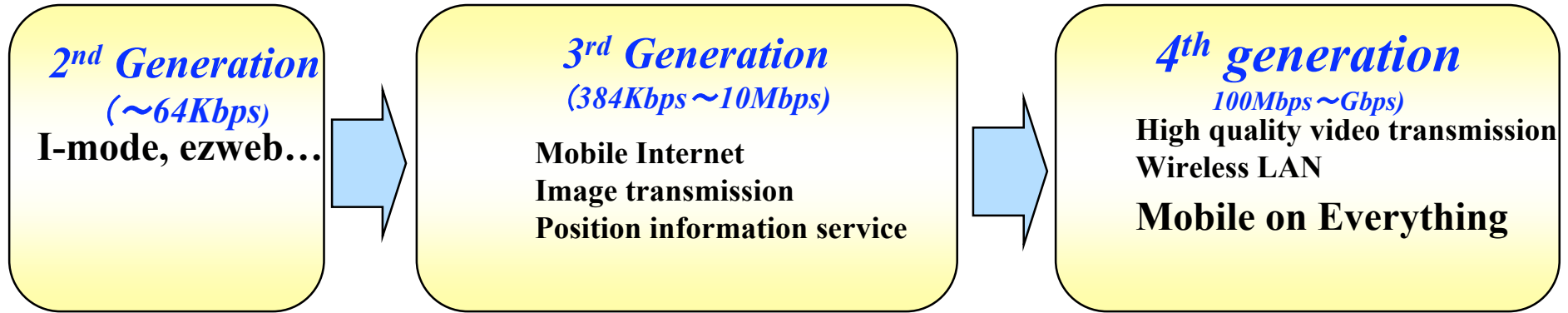


[Source] Gordon Moore, Chariman of Intel cope.

Progress in computer



Progress in Mobile network



Everything is connected
by high-speed radio

Usability

Can access internet in a natural way

Mobile



UI Agent

Easy to use interface

Natural Language Processing

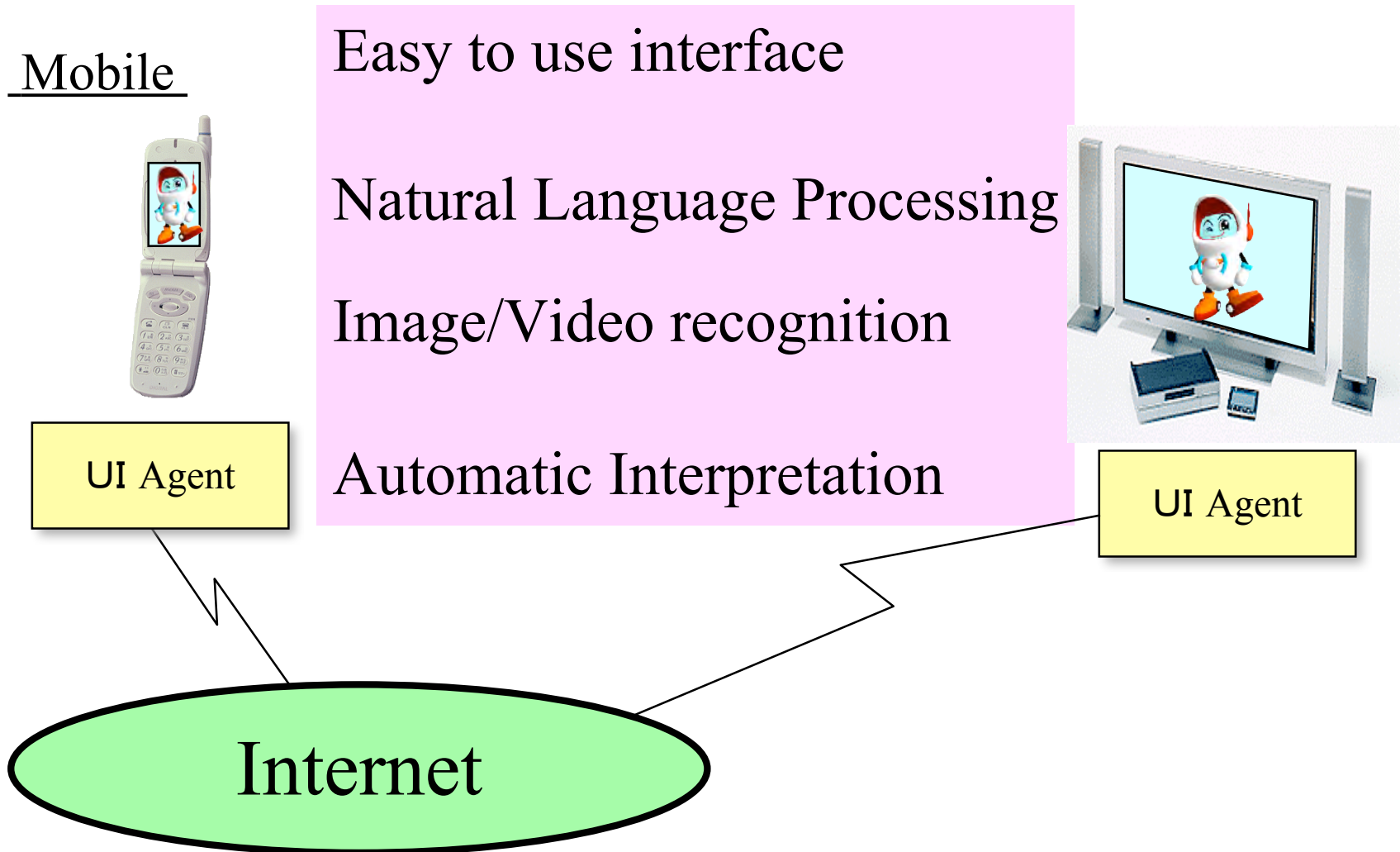
Image/Video recognition

Automatic Interpretation

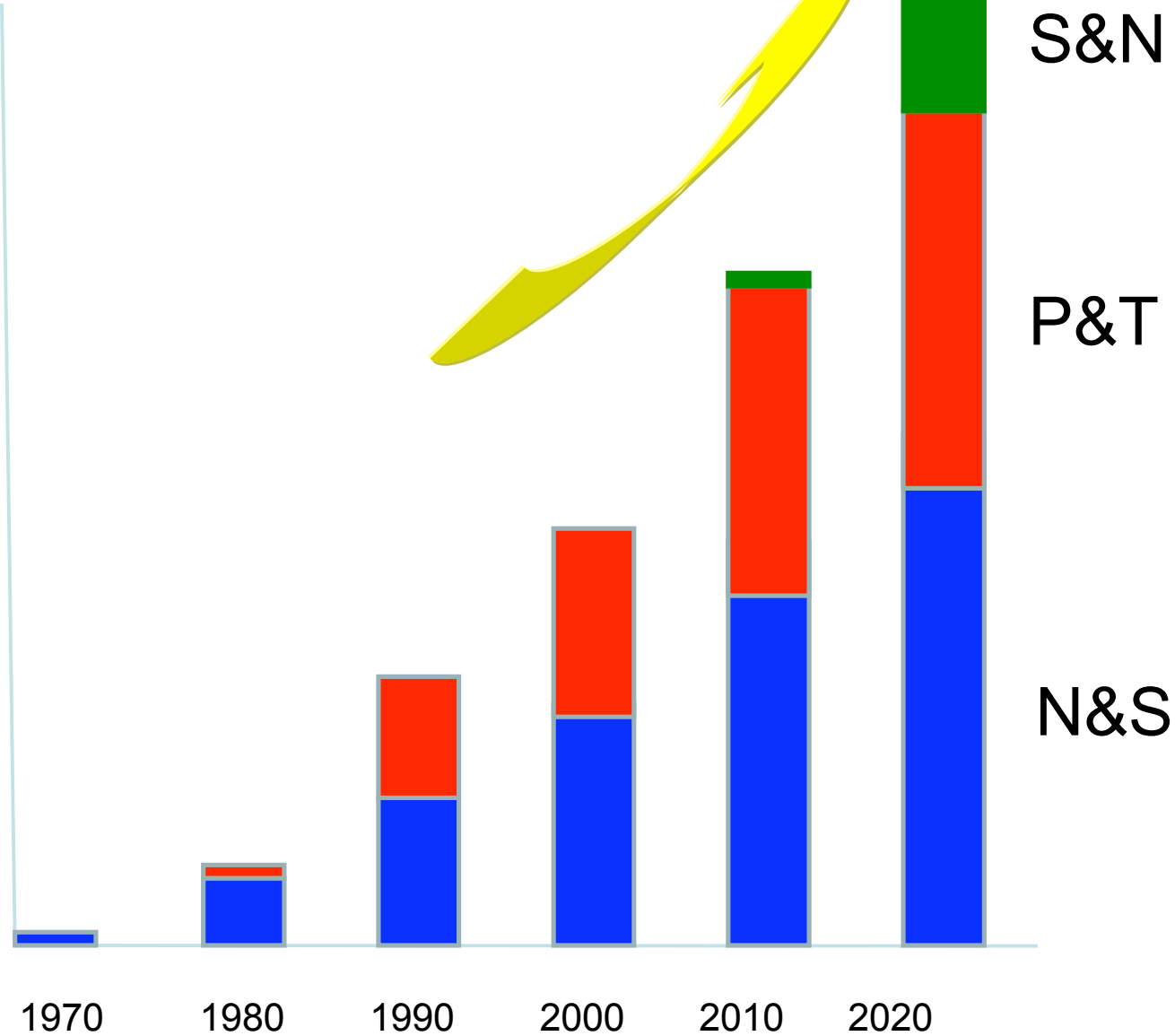


UI Agent

Internet



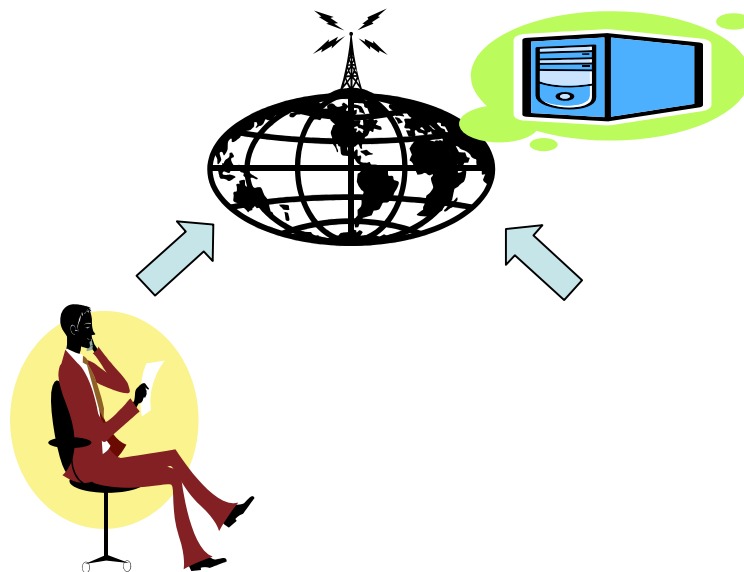
IT/EE Market



To Realize Ambient Information Society

▪ Ubiquitous Information Society

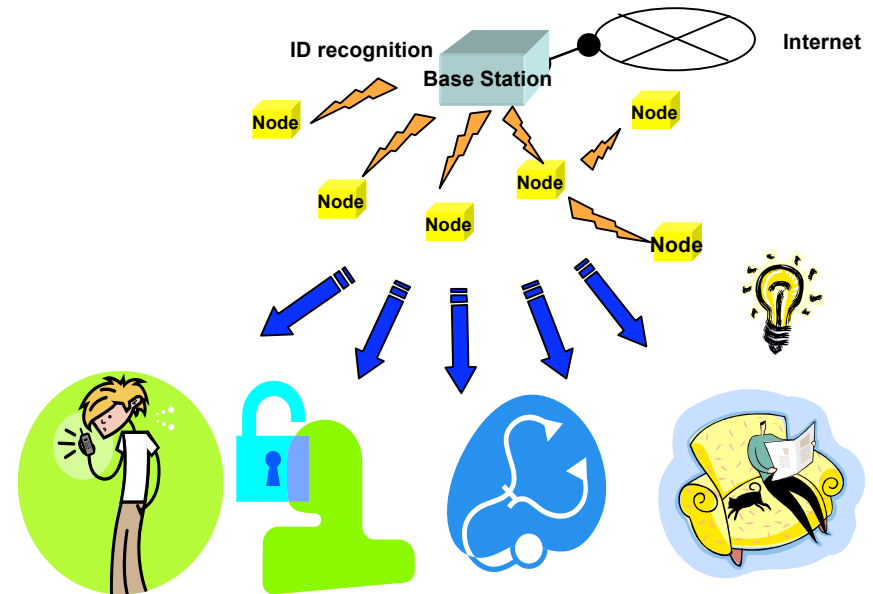
Necessary information is accessible for anybody in everyplace at any time through network



100 million devices;
One device per person

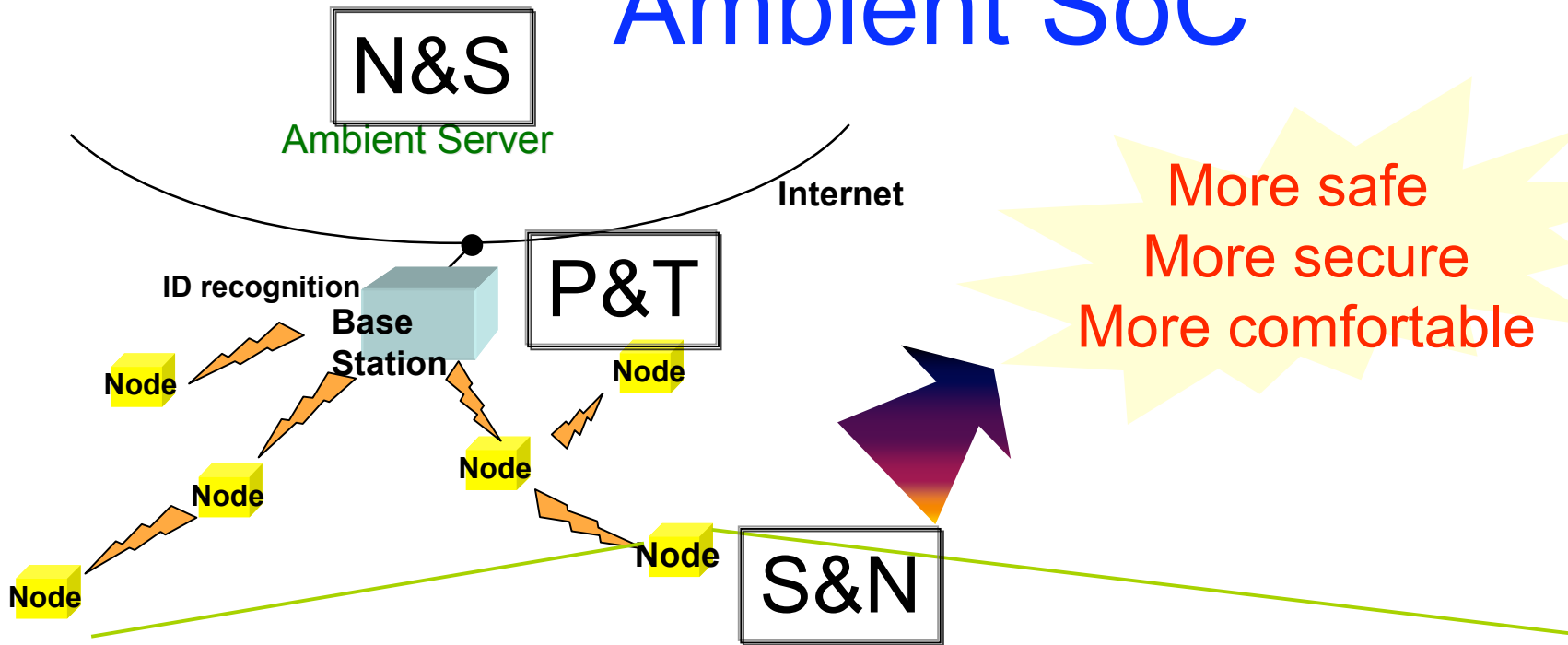
▪ Ambient Information Society

IT exists invisibly, fits well into human life and gives necessary information to anybody safely and securely



Safety, Security and Comfort
10 billion processing nodes;
One node per object

Ambient SoC



To Realize Giga-scale Ambient SoC

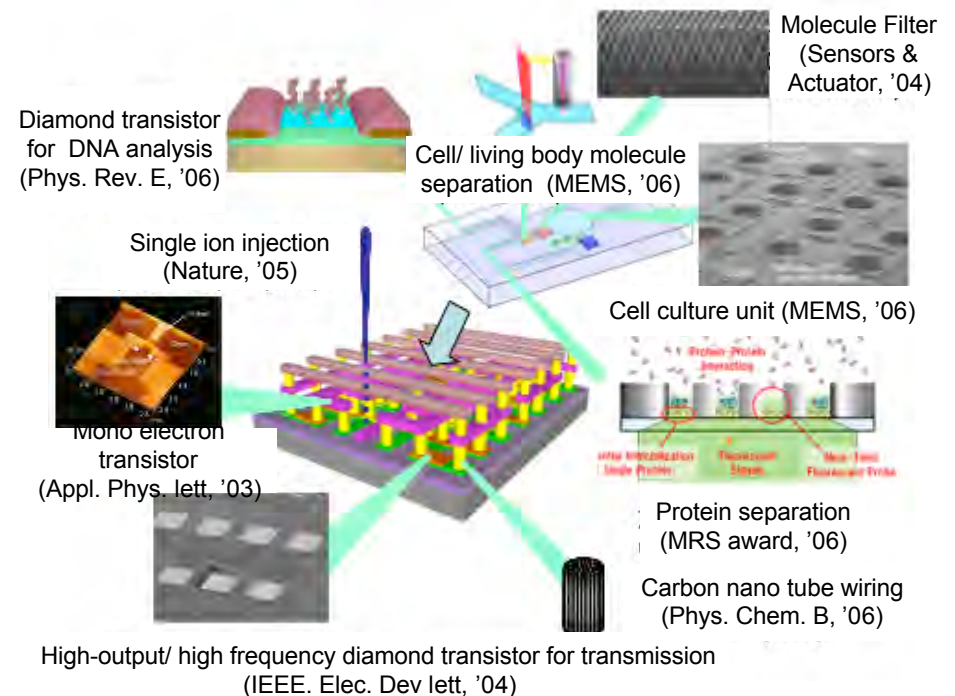
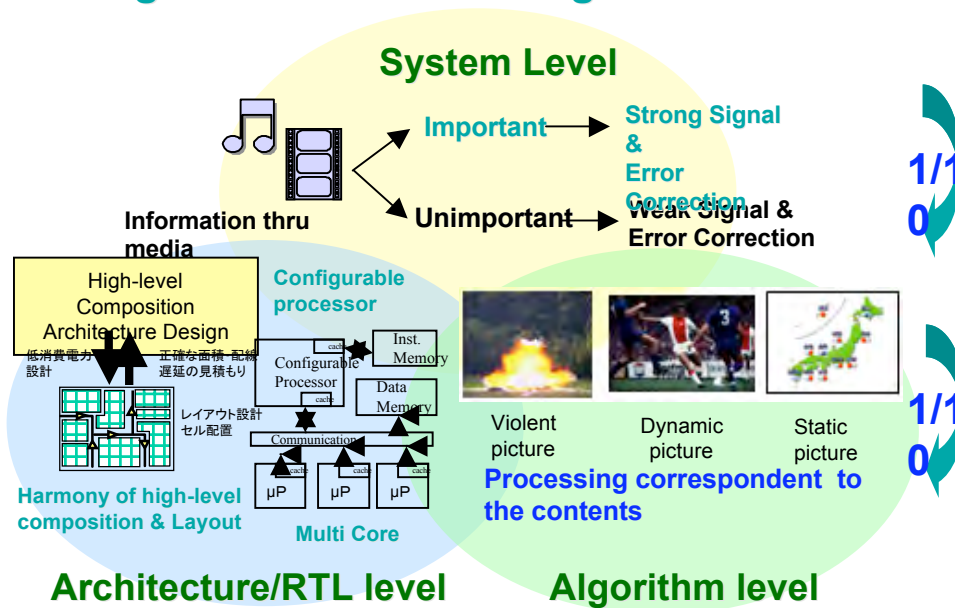
Ambient SoC with 100 million-gate LSI and 100 million-step software : to reduce energy usage to 1/100 & miniaturize the size to 1/10

Issues for AT and IT

Issues for NT

Integration of the process from system design to RTL/circuit design

Ultra-miniaturization with single-ion injection / carbon nano technology



On going as CREST project from 2006 to 2011
Achieved low power consumption by 1/5 of current level

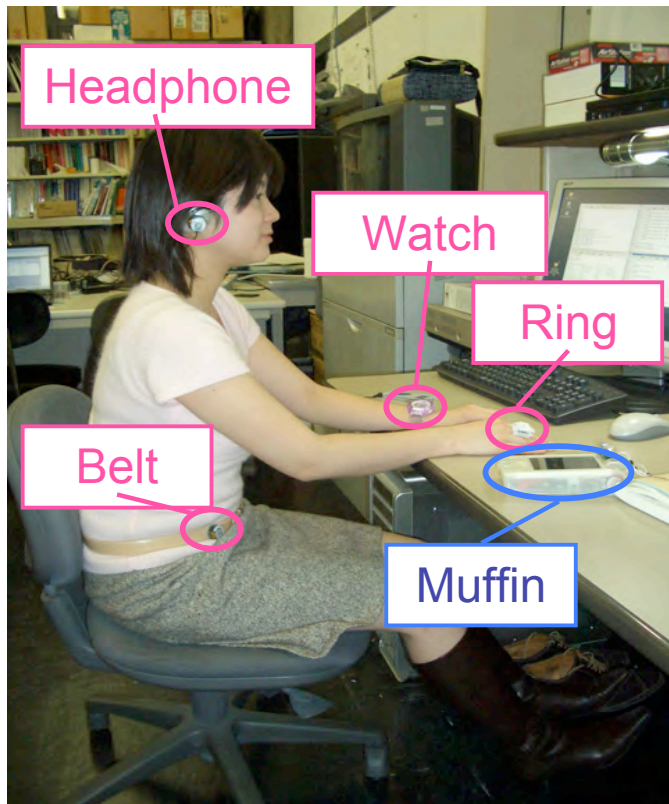


WASEDA UNIVERSITY

Research at Waseda University

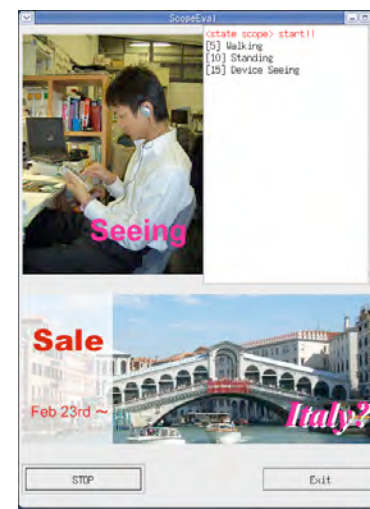
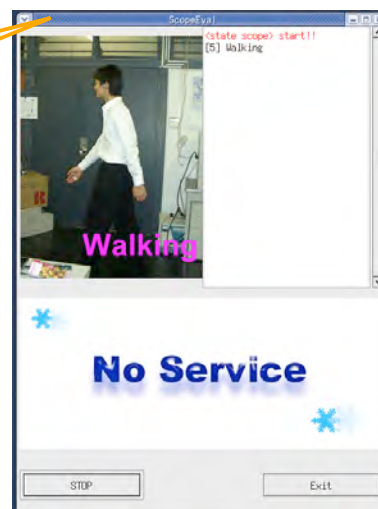
Sentient Personal Device





State Screen

Stop providing a service, when a user is walking or reading a book or sleeping



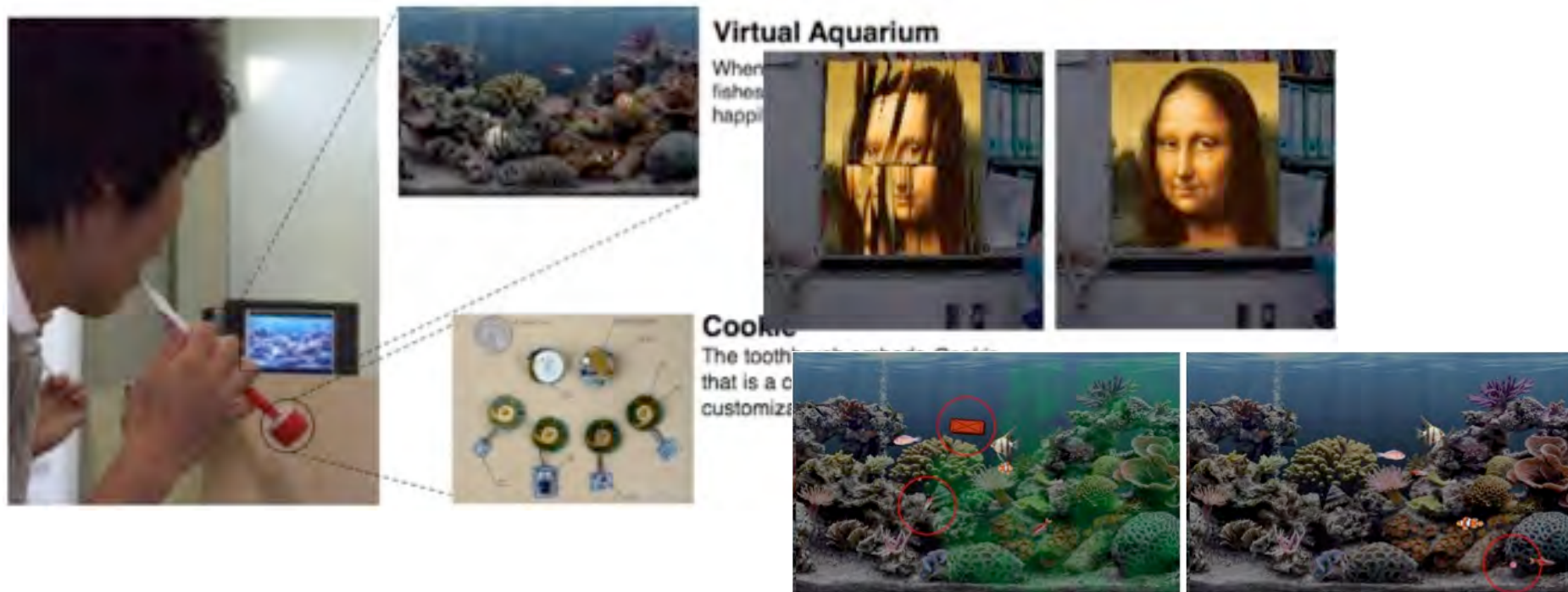
Provide a service, when a user is idle or watching the device

Service Screen

Ambient Lifestyle Feedback System



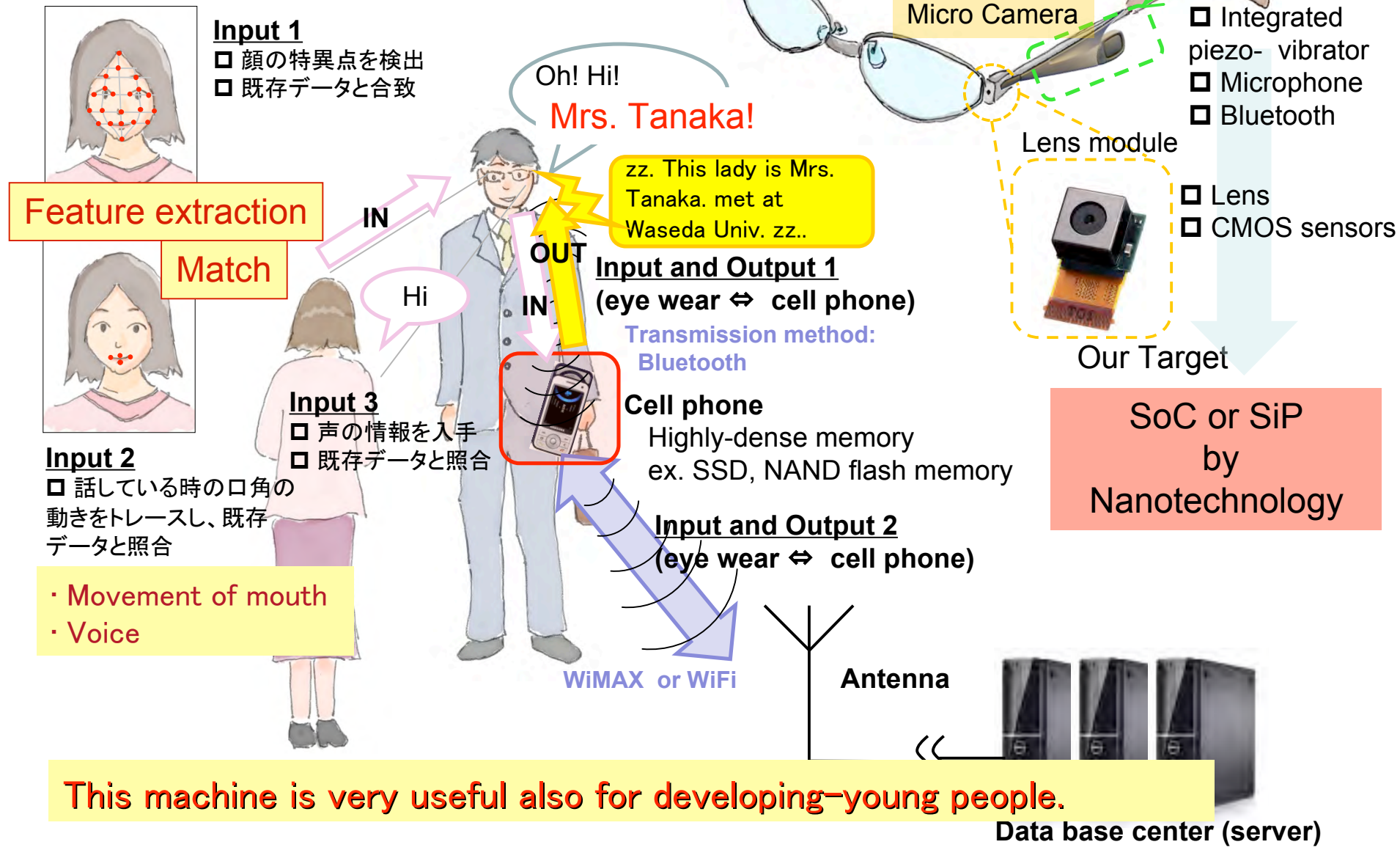
DIS 2008
EuroSSC 2008



Ambient Feedback of a user's behavior through implicit interactive

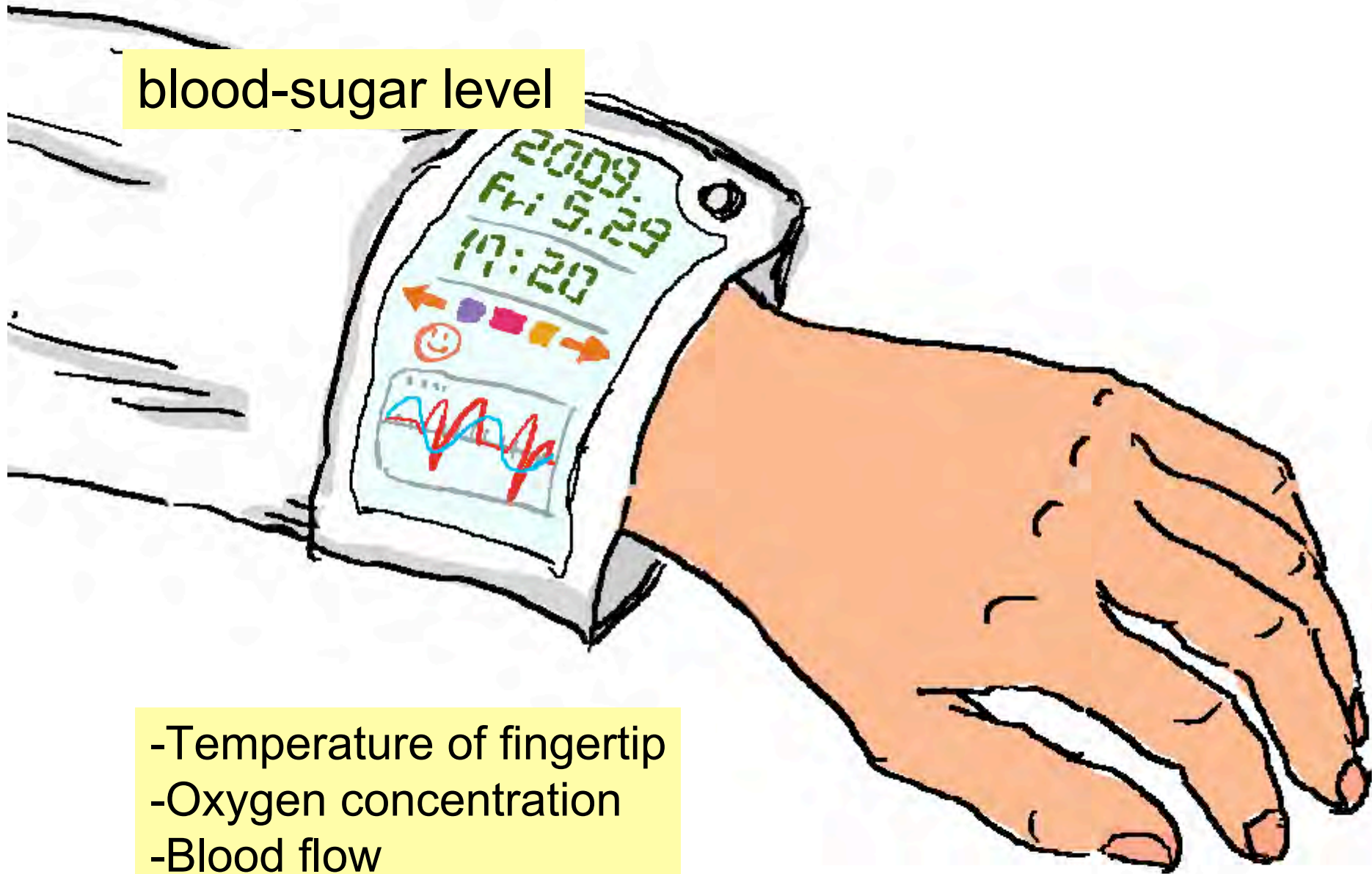
Schematic of a Man-machine interface

High-end eye glasses



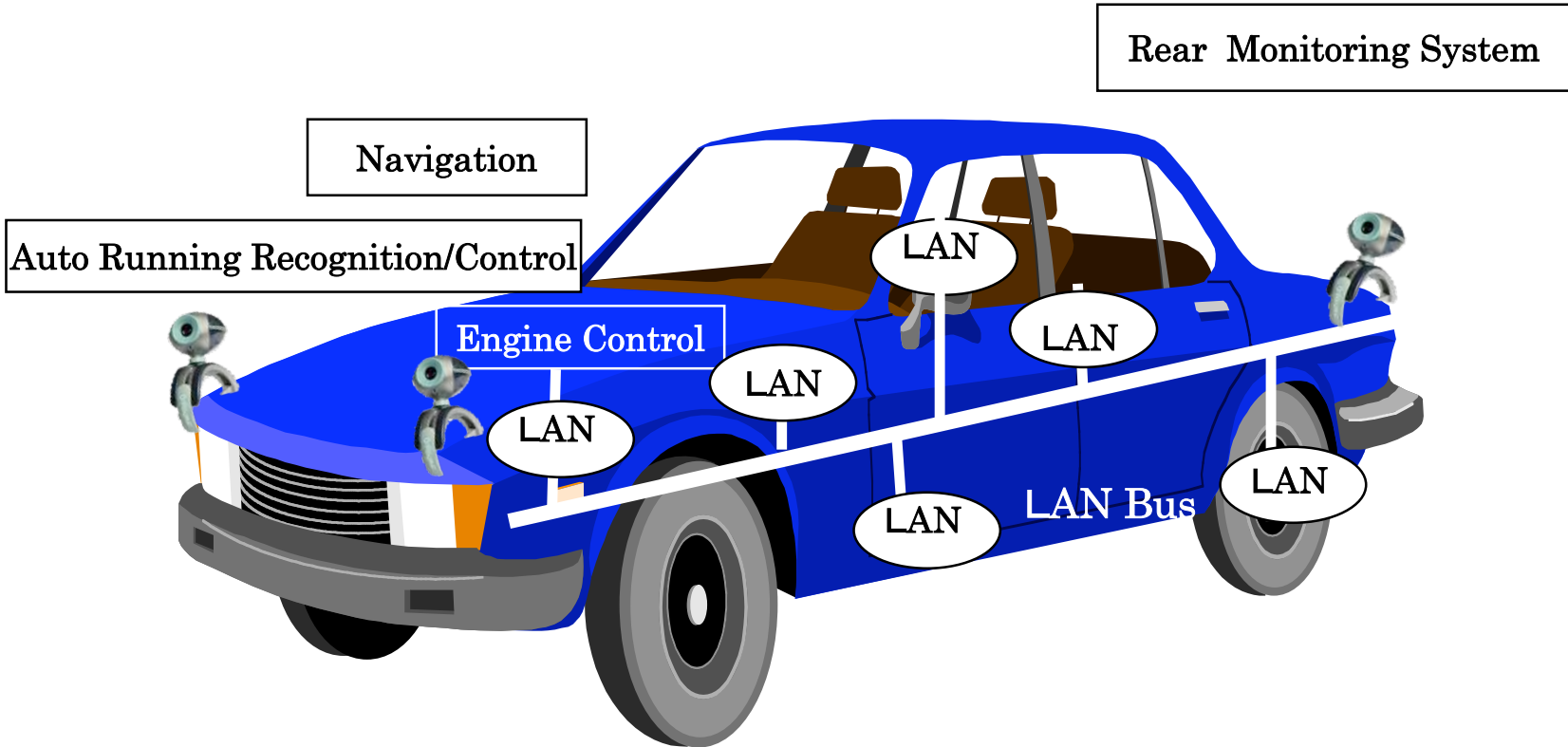
This machine is very useful also for developing-young people.

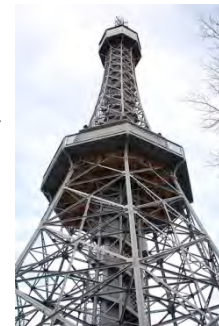
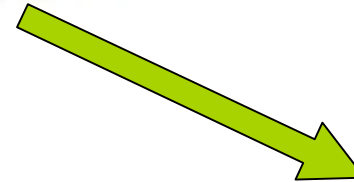
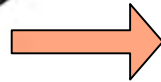
blood-sugar level

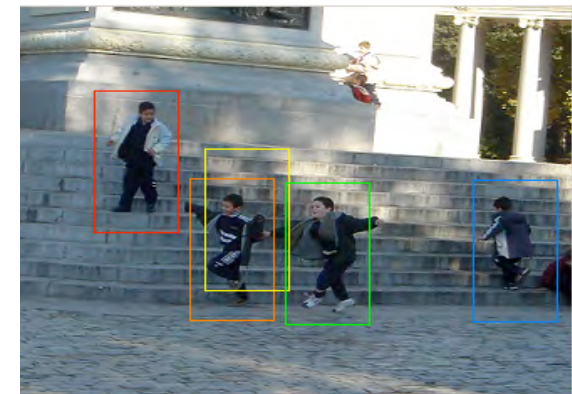
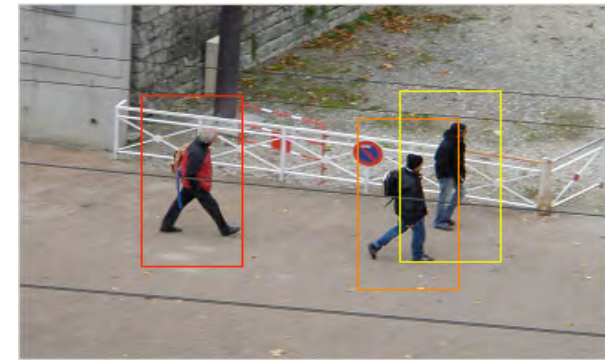
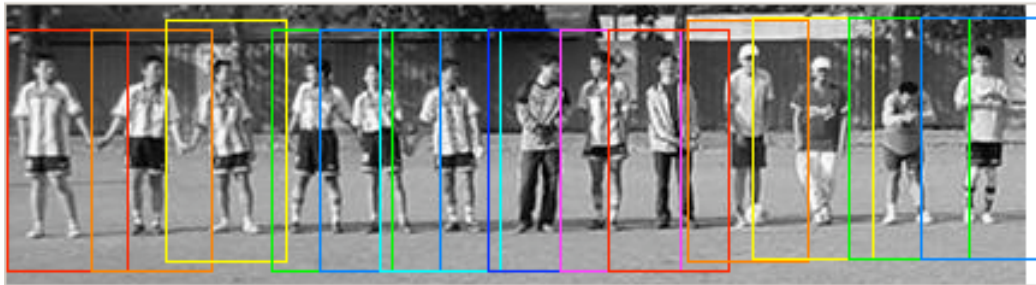


- Temperature of fingertip
- Oxygen concentration
- Blood flow
- Blood-sugar level

Automatic parking System



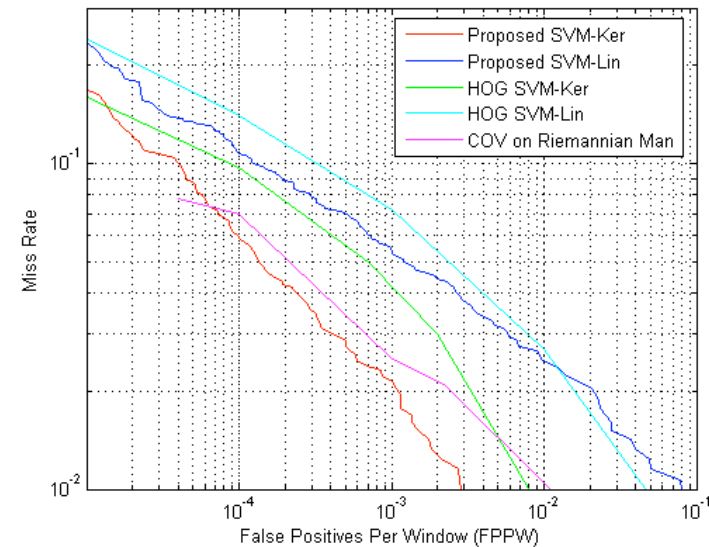
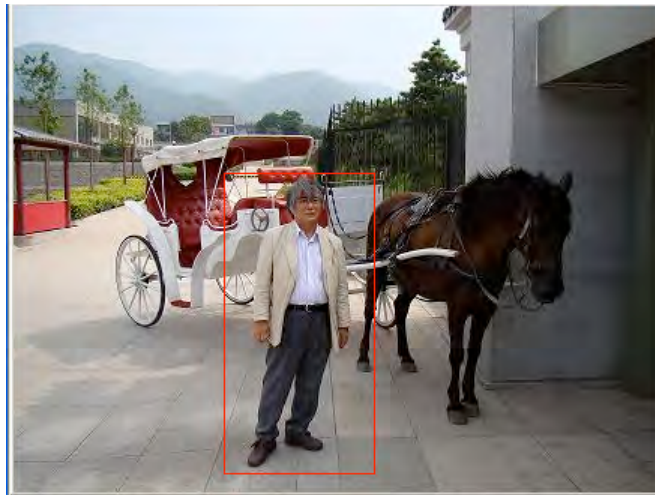
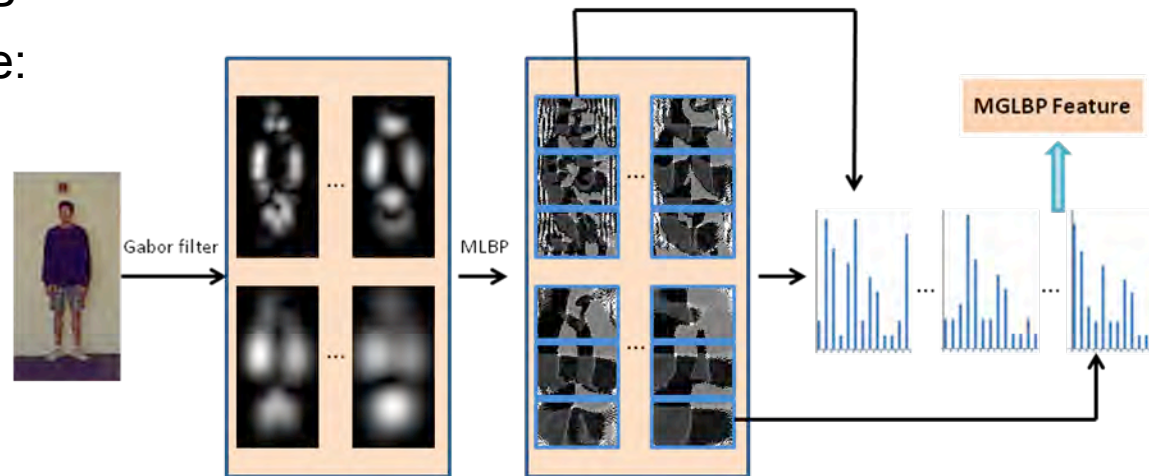




Xin Jin, NTU-Waseda Joint Workshop, 01/23/2009@Waseda, Tokyo

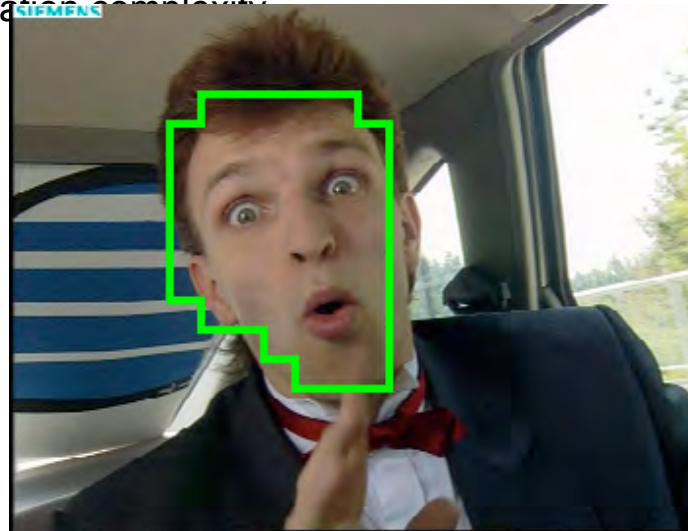
Human Detection and Segmentation

MGLBP
Feature:



Region-of-Interest

- ROI-based low power encoding
 - More power consumed in ROI, less power out of it.
 - Adaptive encoded video quality control
 - Adaptive encoding complexity control
- Technique features
 - Face detection algorithm to detect ROI in videophone
 - Macroblock-based processing
 - Embedded into a H.264/AVC encoder
 - Low computational complexity



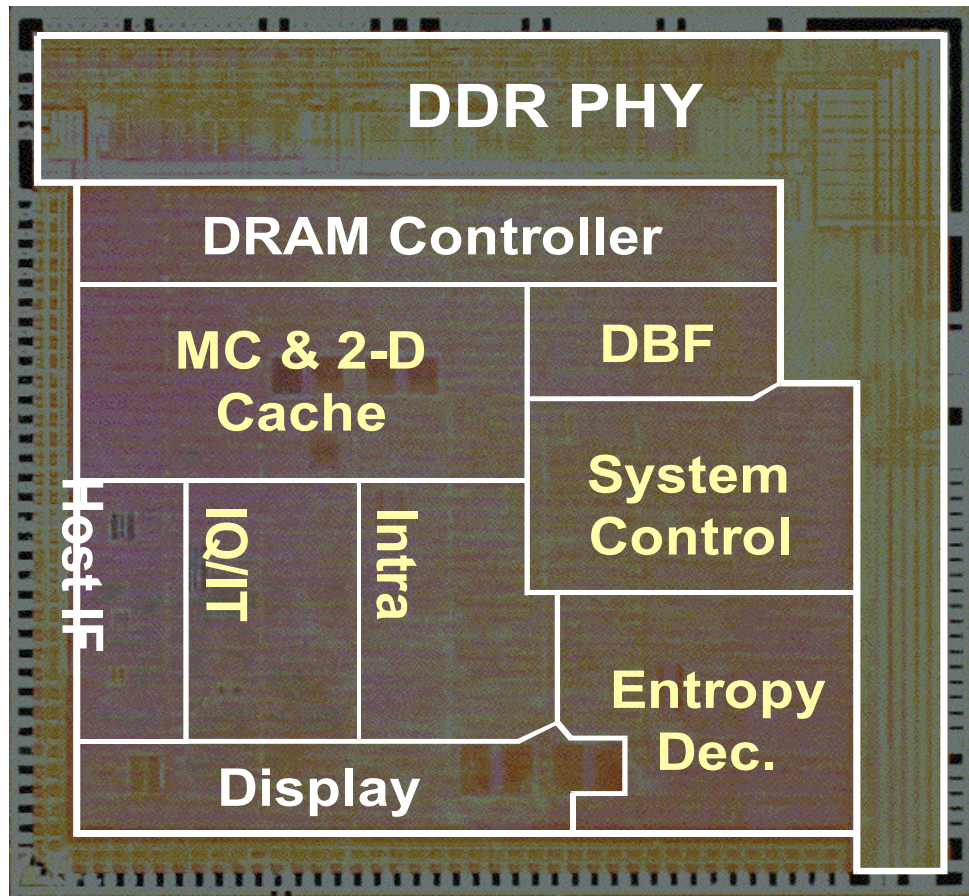
ASTICON2009

Video Surveillance



- Content feature
 - Camera static
 - Burst motion
- Requirements
 - Power efficient
 - Cost efficient
 - Instant stimulate

Video decoder chip

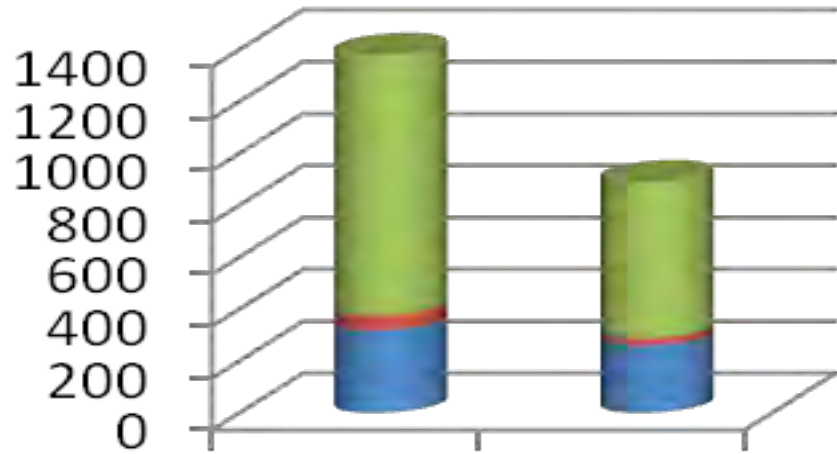


- Chip Param.
 - SMIC 130nm
 - 5x5 mm²
 - QFP 176
- Decoder Core
 - 367k Gates
 - 11.0kB SRAM
 - 1080p60 @200MHz
 - 257mW

Power consumption

735mw

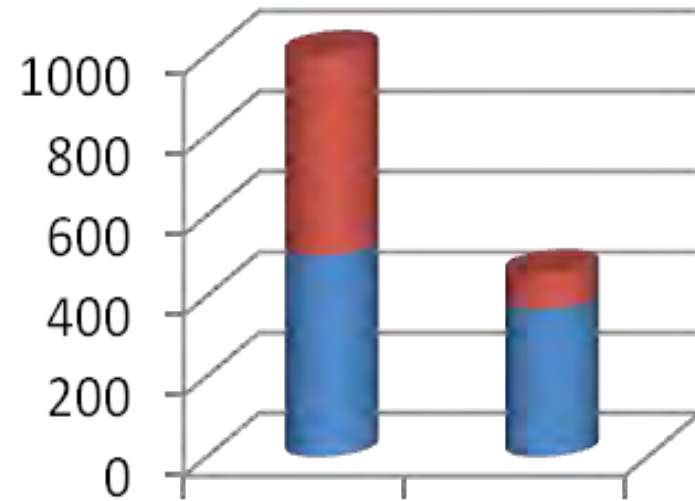
468mw



A-SSCC'08

This Work

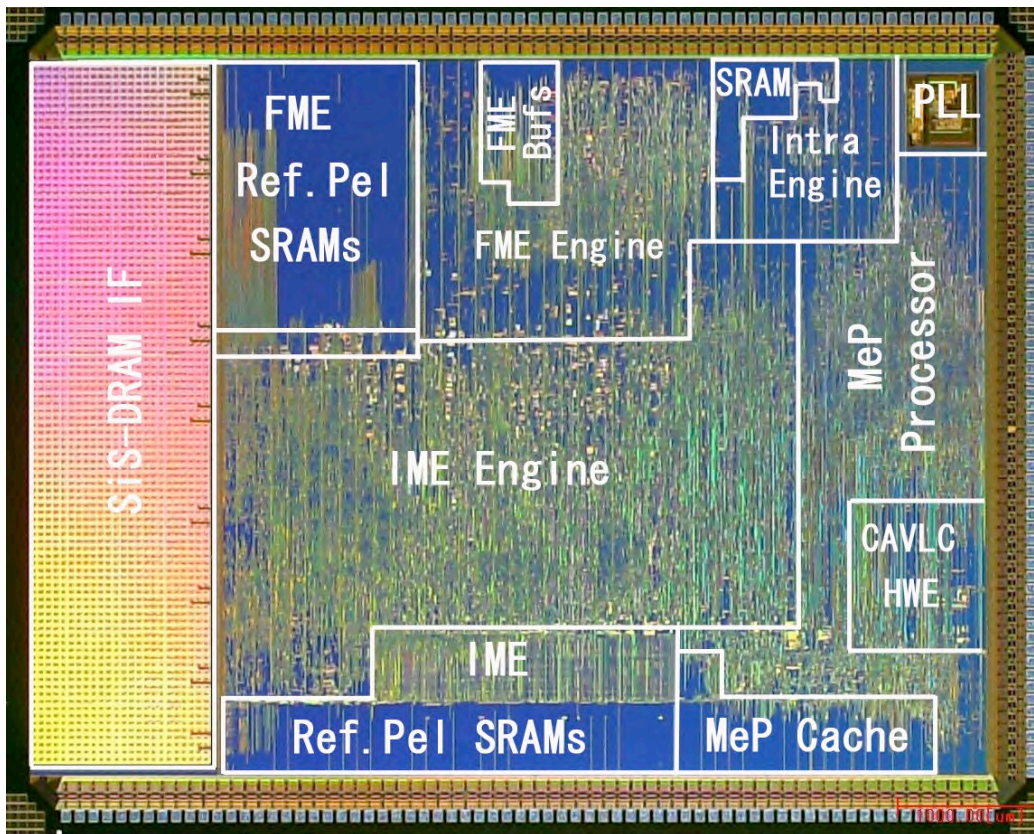
Chip size



A-SSCC'08

This Work

H.264 Full Encoder Chip

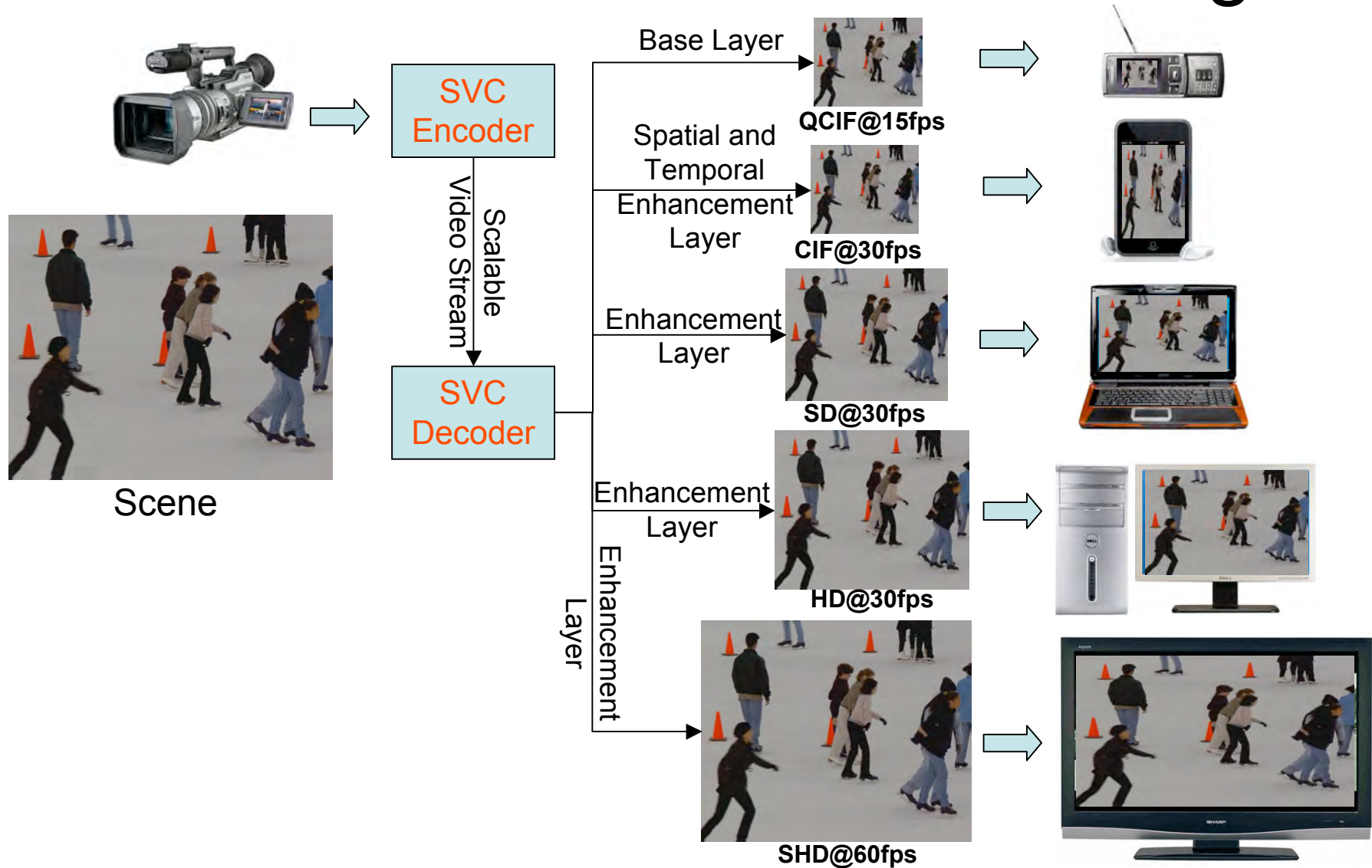


1920x1080
30 frame/S

64Mb System-in-Silicon DRAM
TSMC 0.18um CMOS 1P6M
5.44mm×4.98mm (= 27.1 mm²)
Clock: 200MHz
Power: 1409mw(DRAM is included)
Logic Gates:1140K gates
SRAM:108KB

Symposia on VLSI Technology(2007)

H.264 - Scalable Video Coding

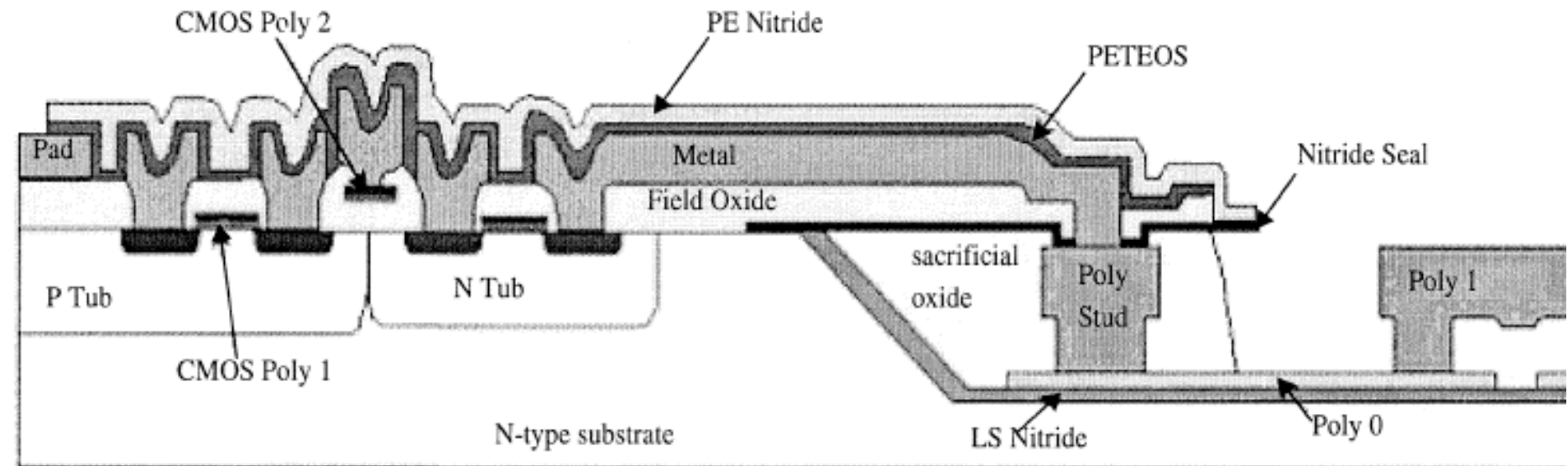


Multi-view Video



an example of process related issues

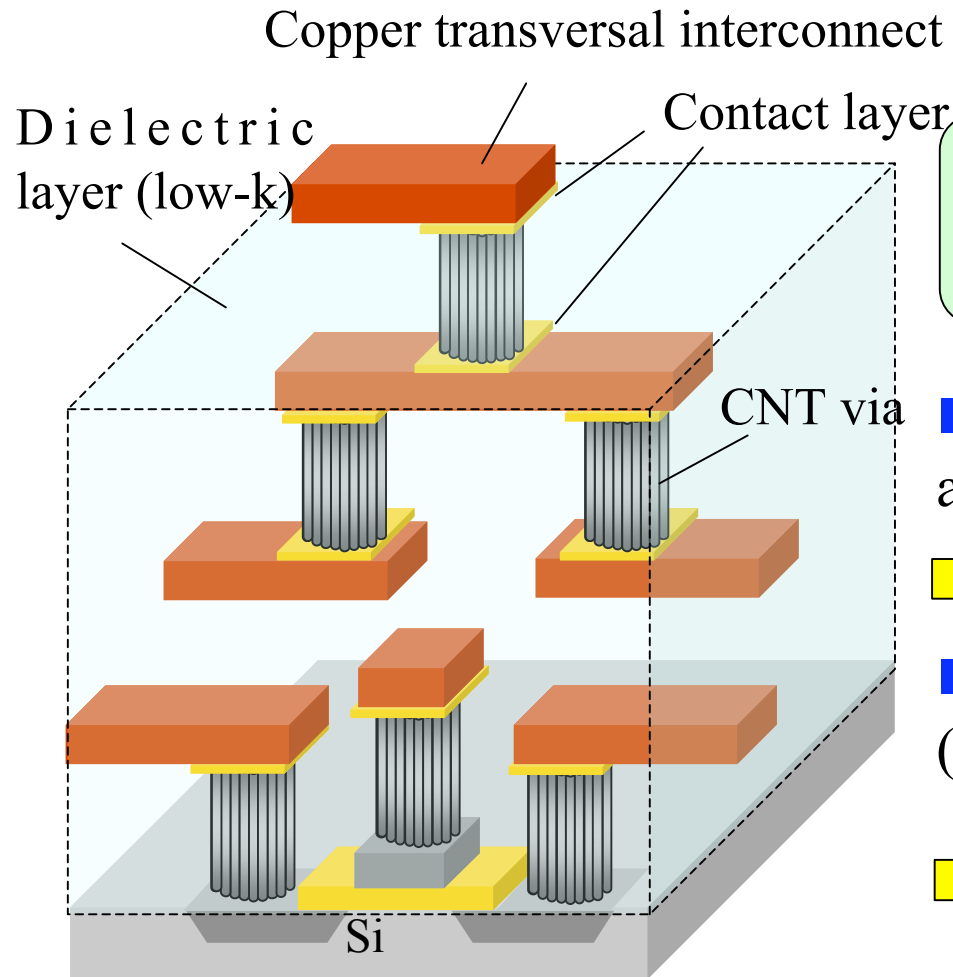
MEMS accelerometer on CMOS



← CMOS device area (signal processing) → ← MEMS device area (sensing) →

↑
This area has to be shielded during deep etching of MEMS area.

The development of CNT-Copper hybrid system



CNT- Copper hybrid multi-layer interconnection

Technologies for CNT application to via interconnects

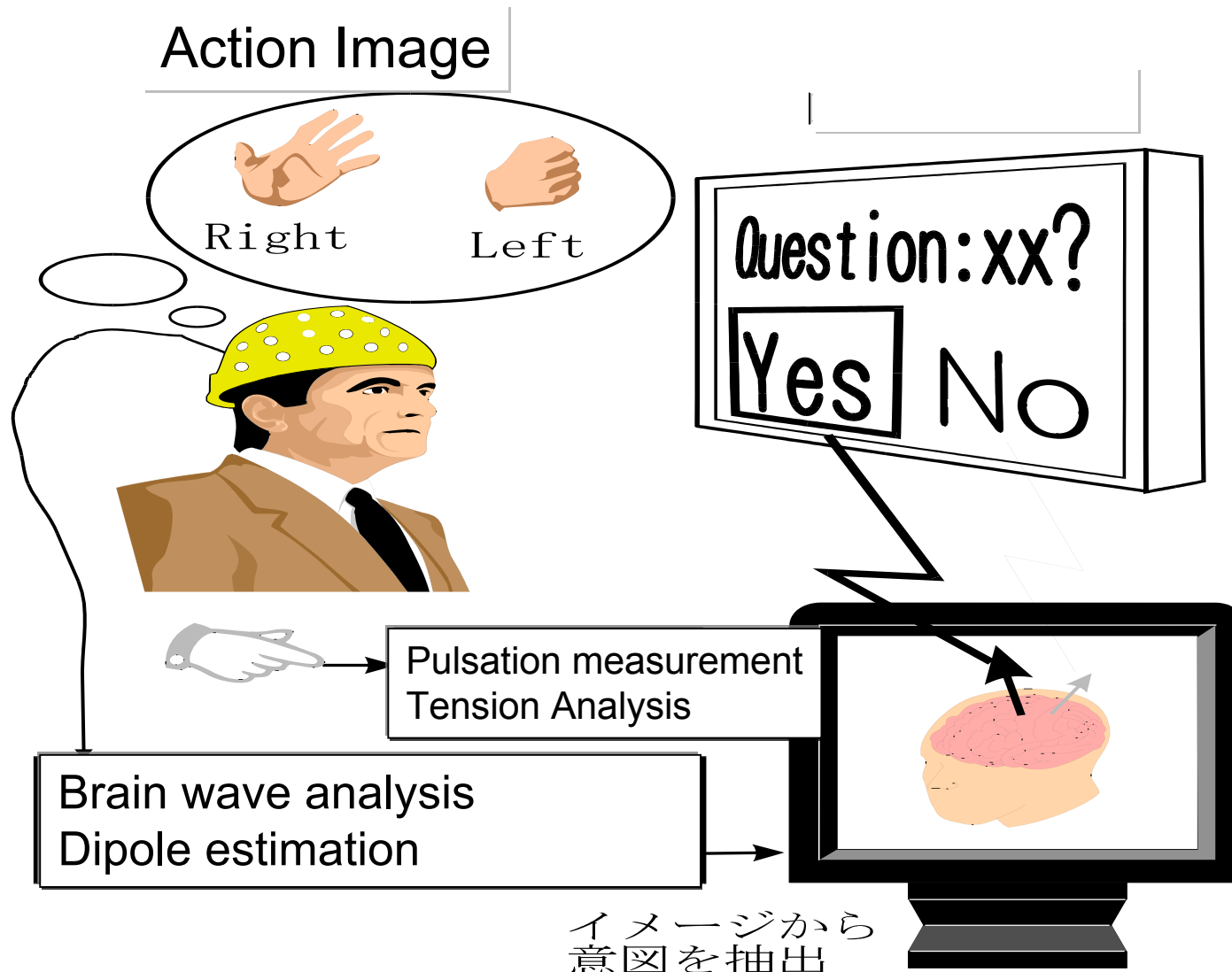
■ Radical CVD apparatus

➔ Realizing the synthesis of CNTs below 400 °C

■ Chemical Mechanical Polishing (CMP) process

➔ Planarization of CNTs via to form upper layers

Intention extraction system from brain wave

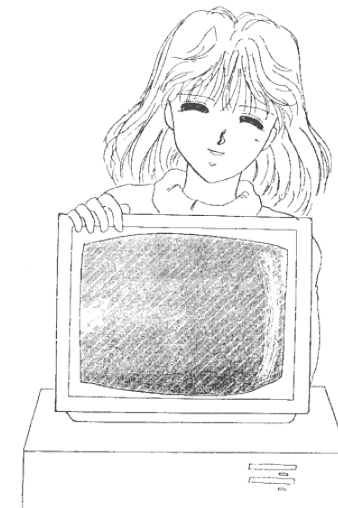


Psychic communication ?

F1 : Dream of Car



Super Computer: Dream of Computer

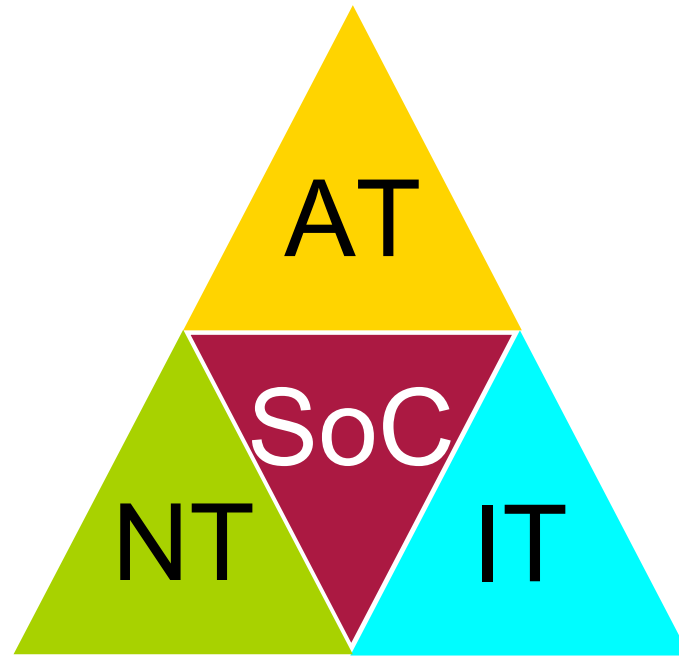


Conclusion

- **Keep the name of EE.**
- **Give a dream to young people.**
- **Change a research subject to a new promising area from classic.**
- **Try to incubate a new attractive and exciting product to the market.**
- **Give education on both of engineering/Science and Marketing to students**

No more 3K

Thank you for your attention



Waseda University