[Plenary Speech 2p.1]Digitally Named World: Challenges for New Social Infrastructures

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Challenges of System LSI Technologies for New Social Infrastructures

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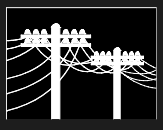
Silicon Sea Belt

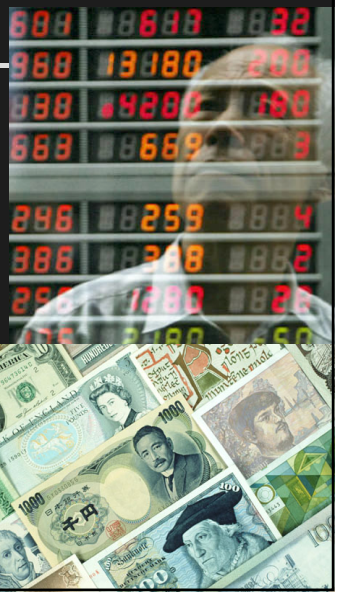
IT as a Basis of Social Infrastructure Systems

- Most social systems were designed and established before 1950.
  - Governmental and economical systems
  - Energy supplies and transportation systems
  - Communication services
- In the second half of 20th Century, ITs were introduced in the social systems.

Rapid Progress of IT Changed Time Constants

- Speed of information transfer and processing has been accelerated drastically by IT. (10^6 10^9 times)
- Basic design of social systems was not supposed the speed up of information spreading. The stability of the systems is not guaranteed.
  - The Black Monday in stock market
  - Foreign exchange market
  - And then… e-commerce, e-government, e-education,…



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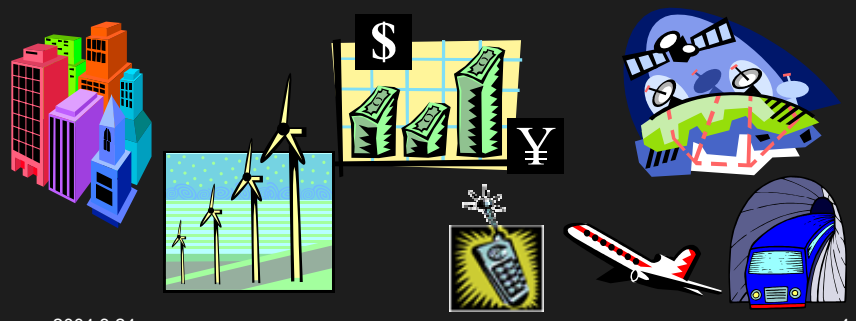
A New Direction of IT

- Redesign and reconstruct the Social Infrastructures and Social Systems based on the advanced information technology.

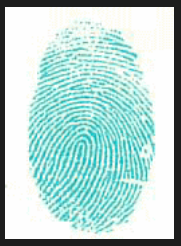


Problem 1

- How to handle Credit, Value and Property on the Network Society?
- e money, e commerce, e government,…
- Personal Identification and Authentication

Face to face

Seal and signature



Finger print

Do you like to receive?

- If your salary paid by Edy card, would you feel happy?

Roman Coin BC 1C

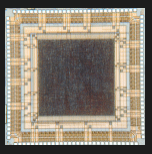
Japanese first bill 16C

First Japanese Yen 1872

?

Problem 2

- You are using more than hundreds of System LSIs in a day.
- How much energy do you spend for communication and computation?
- How much do you like to pay for chips?



Conversion of CO_2 Emission

Electricity	1 kWh	0.357kg
City Gas	1 m^3	2.39kg
Petrol	1 litter	2.31kg
Tap water	1 m^3	0.59kg
Plastic	1 kg	2.64kg

Personal Computer	50	150W
Mobile Phone	200	400mW
TV	30	60W

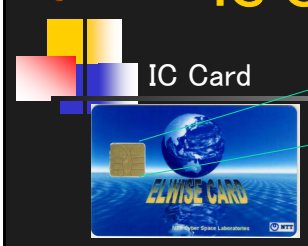
Research Projects

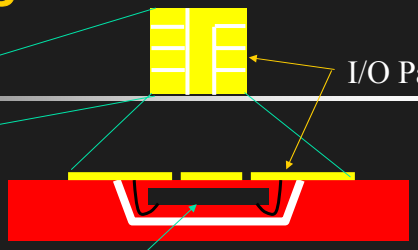
- Digital Naming
  - IC Card and RFID Tag
  - New Social Infrastructure
- Quality Driven Design
  - Security on a Chip
  - Low Energy Computation and Communication
- Silicon Sea Belt
  - Research Business

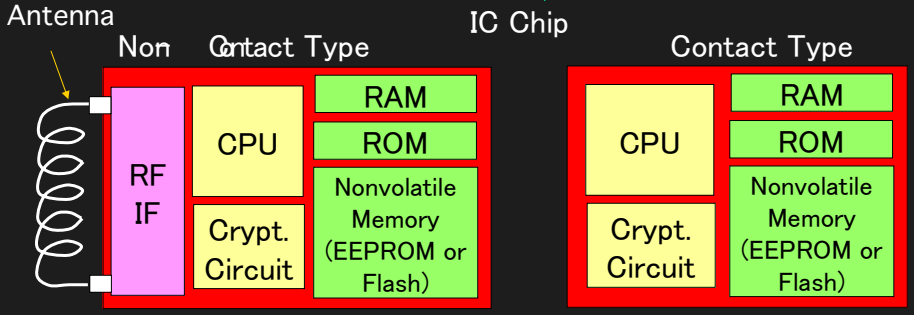
Digital Naming

- IC Cards for Personal ID(IDentification) System
  - Bidirectional Mutual Authentication in Social Systems
  - Naming for People in the Network Society
- RFID Tag (Radio Frequency Identifier) Chip
  - A Bridge between Real World and Virtual World
  - Naming for goods in production, logistics, and recycles
- New Components of Social Infrastructures
  - Ubiquitous Computing and Ambient Computing
  - Combination of Wireless and SoC Technologies
- Digitally Named World

IC Cards



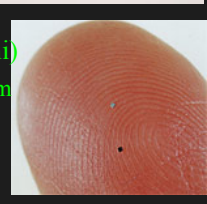


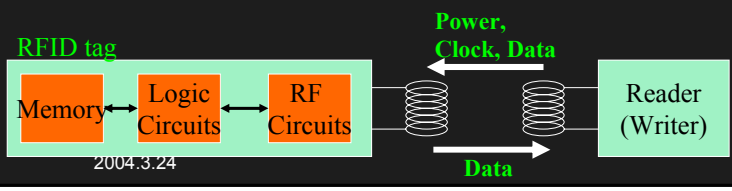


RFID-Tags

- Usually battery less
- Wireless communication and power supply
- Small and variety of shapes:
  - Under 1mm(not including antennas)
  - Cards, Key rings, Labels
- Communication time: about 0.5 seconds
- Communication Distance : Max.5m
- Memory Size: 1 bit～64kbytes

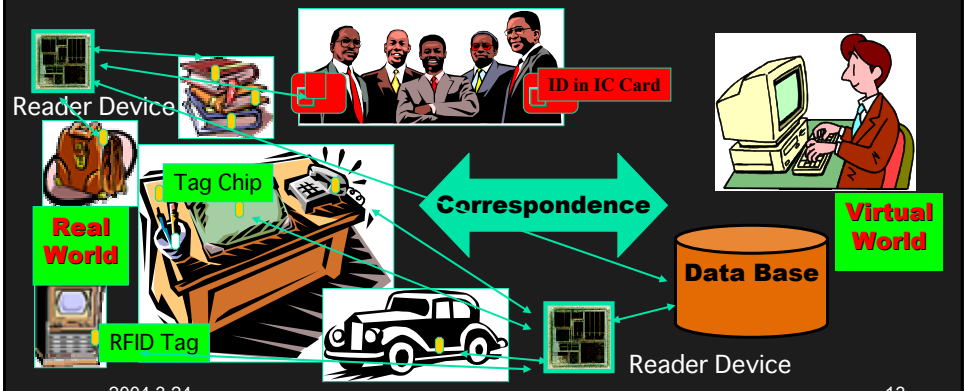
μ Chip (Hitachi)
0.4mm×0.4mm
128bits ROM
2.4GHz





Digitally Named World

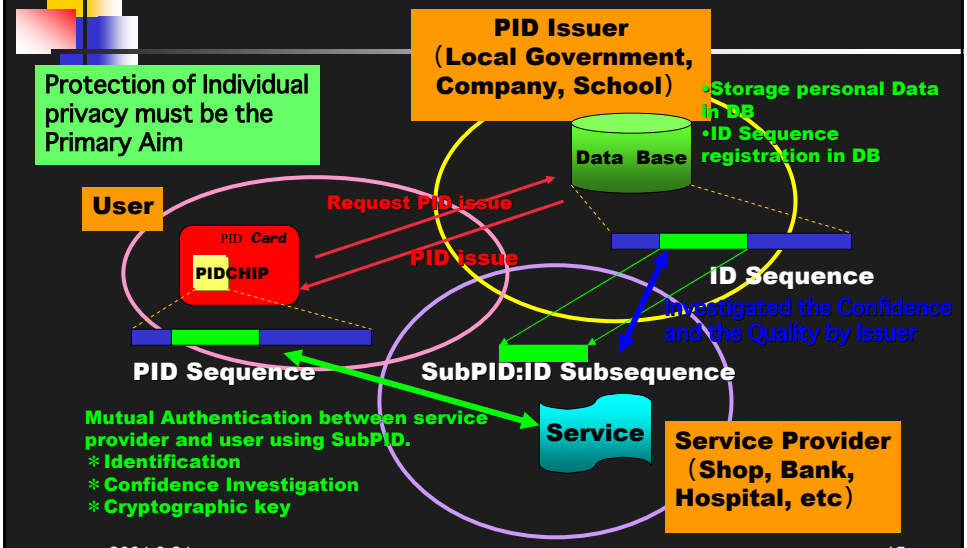
- Naming to every person/product (IC Card, RFID Tag)
- Correspondence between name and entity
- Automatic updates of the status and locations in DB
- Efficient and secure society



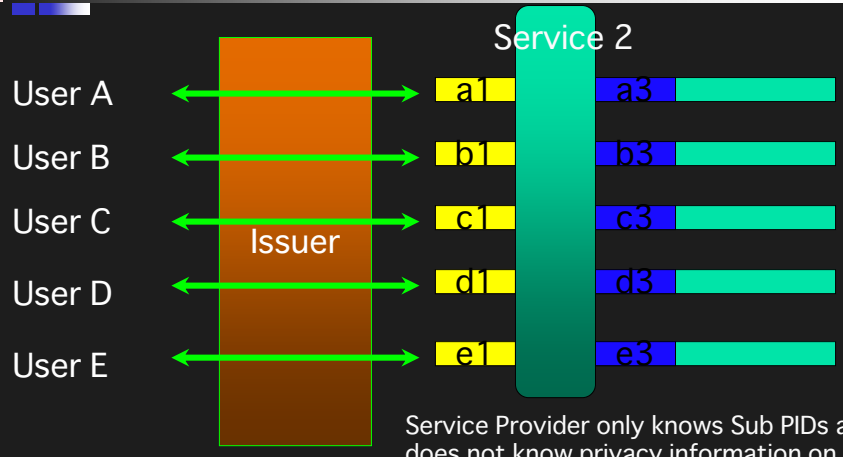
Principles for Design of Social Infrastructure

- Protecting privacy of individuals as well as security of systems and societies
- Simple and comprehensive mechanisms for easily understanding
- Reliability and stability
- Flexibility and extensibility against rapid progress of IT
- Resistibility and recoverability to attacks and crisis
- Economical feasibility and manufacturability
- → Challenges of Information Technology

Proposal of Personal ID System



Basic Structure of PID



Service Provider only knows Sub PIDs and does not know privacy information on users.

Technical Challenges

- IC Cards for Personal ID(IDentification) System
  - Multiple application system
  - Security and Privacy Protection
    - Resistance to tampering
    - Anti-counterfeit technology
  - Low power RF and cryptographic computation
  - New Business Models
- RFID-Tag (Radio-Frequency Identifier) Chip
  - Small implementation of RF and memory functions
    - Size, shape, weight and cost (cf. Bar code)
    - Manufacturability
    - Resistance to various stress (force, heat, water, etc.)
  - Security and Privacy Protection
    - Anti-counterfeit technology

Project Q
Digital Naming on Campus

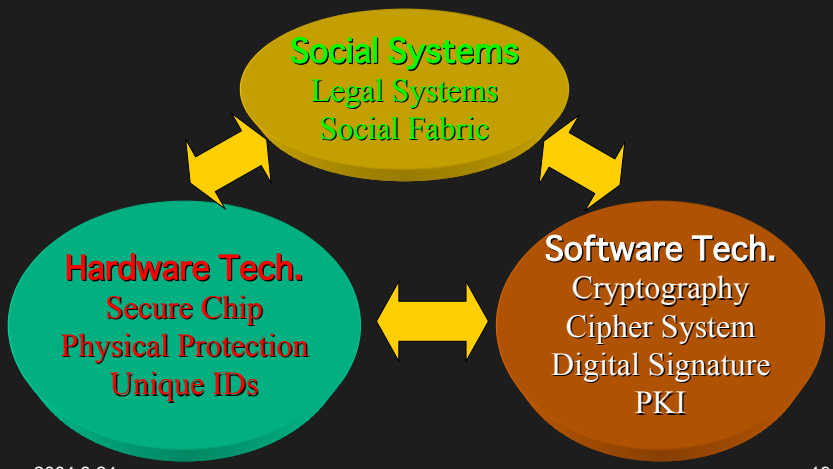
• Experiments for Digital Naming in moderately unrestricted society:

•Campus Card with PID
- •IDs for students, staff with multiple usage
- •Keys to buildings, facilities, and parking
- •Access control to campus information
- •E-money
- •E-administration
- •Services to Students
- •NTT, Panasonic etc.

•RFID Tags to Equipments
- •Library
- •Equipments management
- •Hazard identification
- •Moving to the new campus

New campus of Kyushu University Open in 2005.

Technologies for Security



Quality Driven Design

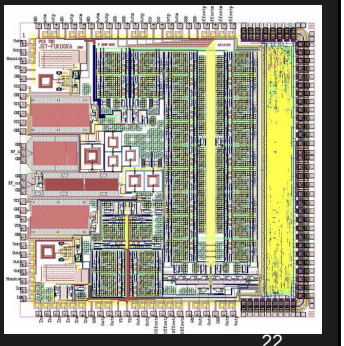
- Present Measures for Design Quality
  - Cost and Performance
  - Functionality
  - Energy Consumption
- New Quality Measures
  - Quality of Processing
  - Security and Creditability
  - Reliability

New Requirement for Design Quality of IC Cards

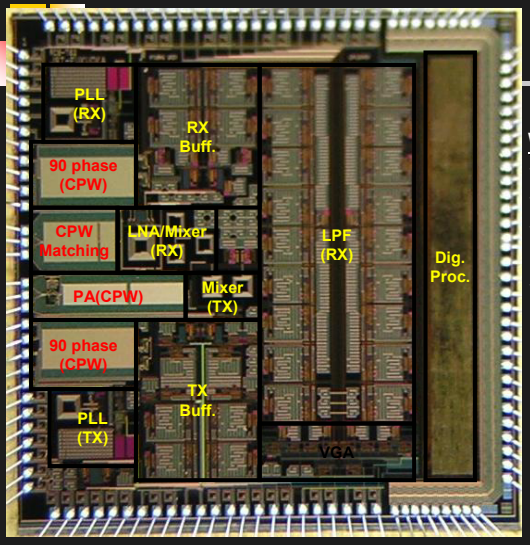
- Security on a Chip
  - Resistance to tampering
  - Secure design, verification, fabrication and testing
    - As secure as Mint Bureau
- Creditability
  - Authentication of a Chip
  - Electrical and Non-electrical (optical and mechanical methods) testing

Design Method for Low Energy Mobile System LSIs

SoC Design Technologies for Mobile Systems
- 1 Chip CMOS Solution for RF Circuit
  - CPW Circuits on CMOS
  - SoC and SiP Solutions
- Low Power Design and System Architecture for communication
- Coding and Cryptography
- Wireless Power Supply



IEEE802.11b CMOS Circuit



Wireless LAN(0.25 μm CMOS)

- ✓ IEEE802.11b
- ✓ 2.4 GHz
- ✓ Matching and Phase Shift by CPW
- ✓ Low Energy Digital Circuits

0.25 μm CMOS (TSMC)
5 mm X 5 mm

Technical Challenges

- Low Energy Architecture and Circuits
  - Dynamic Voltage and Pipeline Depth Scaling
  - Bitwidth Optimization
  - Active Bit Control
- Trade off between Communication Quality and Energy Consumption
- Trade off between Cost and Test Quality

Silicon Sea Belt

- Silicon Sea Belt is a center of semiconductor fabrication.
- This area is also the world largest market of IT industries.
- Fukuoka is addressing to establish a Center of Excellence for SoC design in this area.

- Collaboration in Silicon Sea Belt.
  - ■ Pipelining for SoC products
    - > Marketing and system planning
    - > SoC Design (SW and HW)
    - > Fabrication (Silicon and board)
    - > Testing (from chips to systems)
  - ■ IP exchange market
  - ■ Human resource sharing

Structure of SSB Fukuoka

Higher Peaks of R&D
- •System Design
- •SoC Design
- •Fabrication
- •Testing
- •Applications

CLUSS Projects (2002-2007)
Low Power, RF, EDA, SiP, Reconfigurable Systems, Embedded Software

Human Resource Development
- •Students
- •Engineers
  - Design/Fabrication
  - Sales/Investment
- •Managers/Investors
- •Researchers
- •Teaching Stuffs

System LSI College

Wider Range of Technologies
- •Marketing and System Design
- •SoC Design
- •Fabrication and Testing

Kyushu Semiconductor Cluster Plan

System LSI College

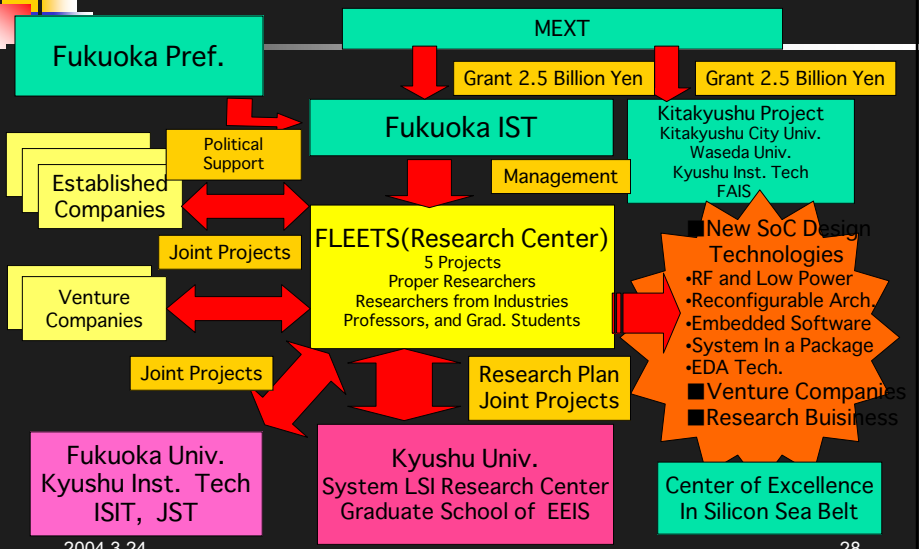
- objective
  - Under liaising of Academy, Industry and Government, the college foster well-qualified System LSI design person, and train them pragmatically.
- characteristic point
  - lecturers as 31 faculties from 18 Universities, and 20 qualified technologists from various enterprises.
  - pragmatically education consists of practical training (3 days - 4 weeks)
  - High quality original teaching material.

Attendees companies

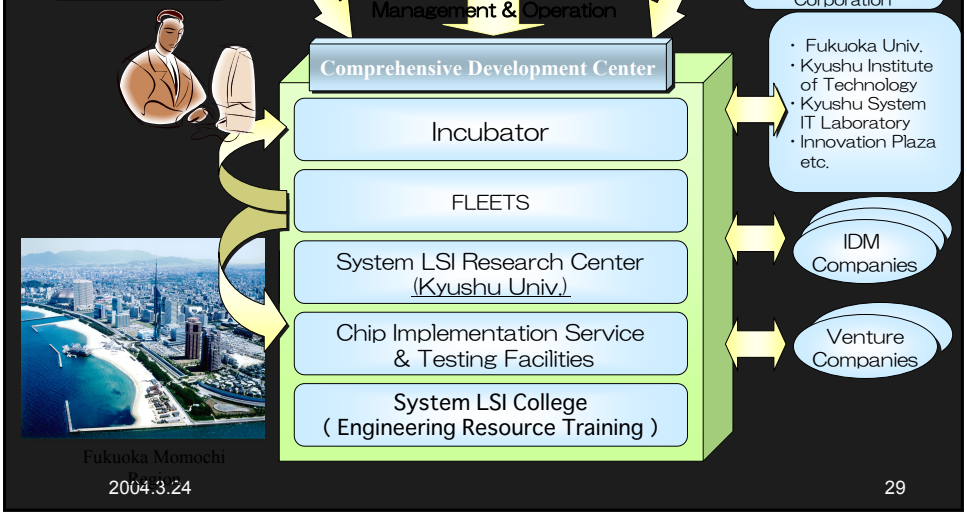
IP Square, Kyuki, Kyushu Electric, Kyushu Mitsumi, JMNet, Seiko Epson, Sony semiconductor Kyushu, TAM, Toppan Print, Toppan Technical Design Center, Hitachi ULSI systems, Logic Research etc.

1,000 design engineers (2001.12～2004.3)

CLUSS : Innovative CLUster for Silicon Sea Belt



System LSI Design and Development Center



Conclusions

- Digitally named world requests new quality measurements of IC design.
- Collaboration among software, hardware and social technologies is important for creating a new Social Information Infrastructure.
- Quality Driven Design is a new direction of design technology.
- Silicon Sea Belt will be a world center of IT technologies.

Research Projects

Projects	Staffs	Students	Partner
Project Q	Sozo, Baba, Shinozaki, Ishida, Hamasaki, Noutomi, Yamaguchi	Nohara, Watanabe, Oyama	Kyushu Univ., Sakurai Lab., NTT, Matsushita, Kumahira, ACS, Q-den Infocom, ISIT, IST, Toppan, etc.
Q D D	Tsujimoto, Nakashi, Ike	Muroyama, tarumi, Mori, Yamaguchi, Adil, Lai	FLEETS, IST, Yoshida Lab. Kuroki Lab., Logic Research, Sanyo, NEC Microcomputer
Theory		Uddin, Makiyama	Yamashita Lab.


SLRC
Thank you !