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Silicon Sea Belt Fukuoka Project

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https://hdl.handle.net/2324/9120

出版情報：SLRC プレゼンテーション, 2005-10-19. 九州大学システムLSI研究センター
バージョン：
権利関係：

Silicon Sea Belt Fukuoka Project

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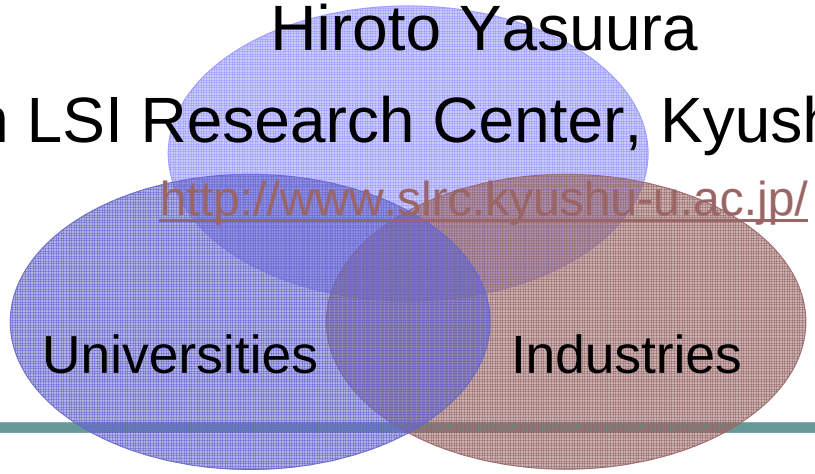
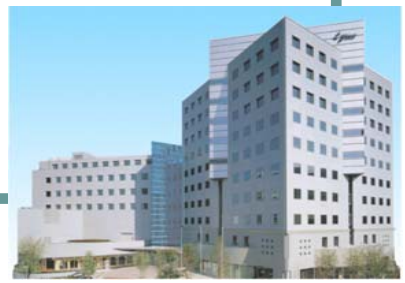
http://www.slrc.kyushu-u.ac.jp/



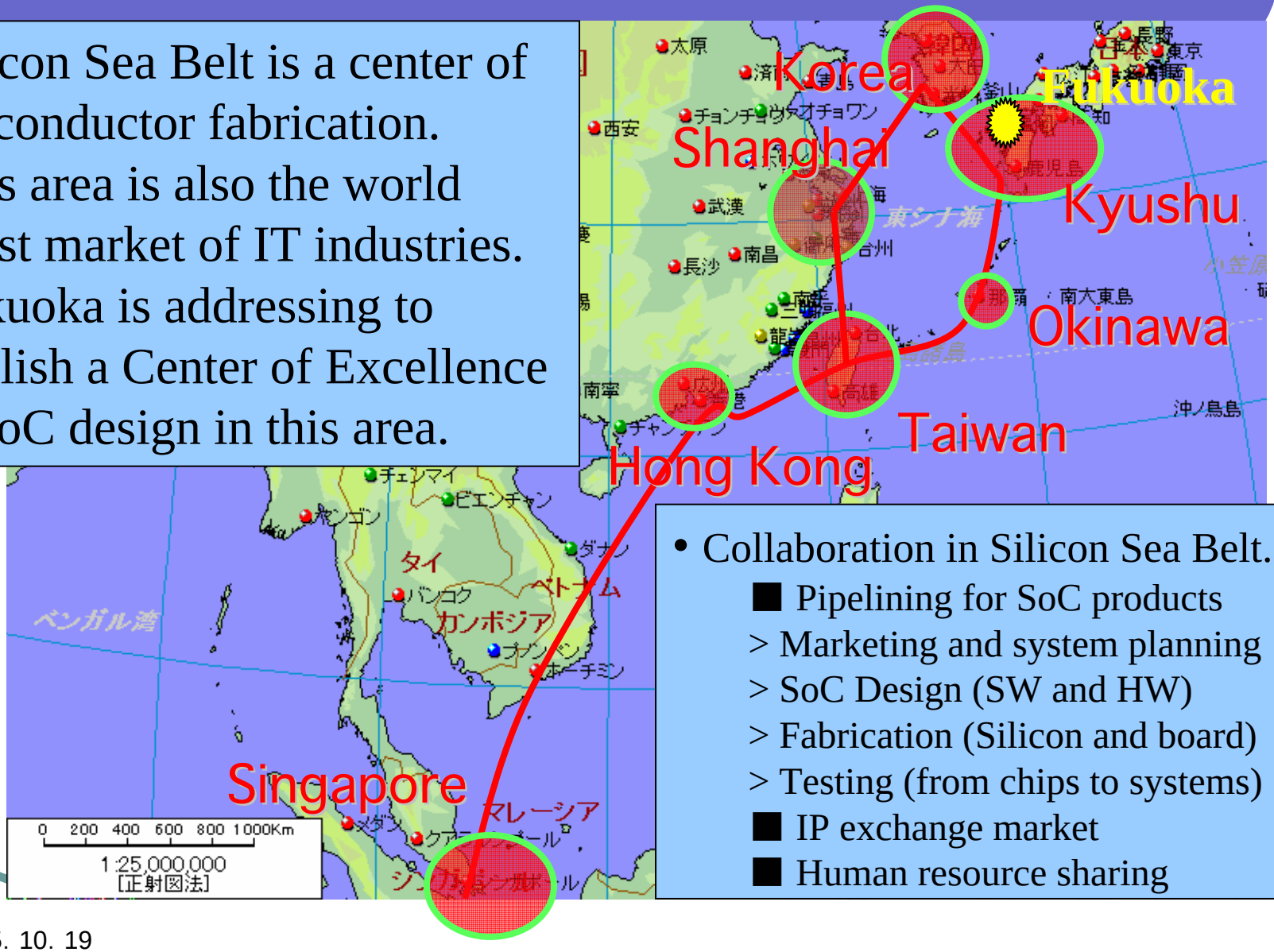


Silicon Sea Belt Fukuoka

What is Silicon Sea Belt?

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

Pipeline Model of SoC Industry in Silicon Sea-Belt

Concept Making and Specification
- Development of new services and concepts of new systems
- Specification of SoC
- Experiments in a domestic market

Design and Optimization
- SoC as a part of systems
- Collaboration with fabrication and test technologies
- Advanced design technology

Mass Production and Consumption
- The largest market in the world
- Advanced mass fabrication technology
- Difference from U.S. and European markets

Research and development of new applications Marketing

Research and development of a new SoC design technology

Creation of new society and culture with information technologies

Taiwan, Korea and Japan

China

Location of Kyushu

Convenient Fright Routes

From Fukuoka
200km: Pusan
500km: Osaka, Seoul
1000km: Tokyo, Shanghai
1500km: Sapporo, Beigin, Taipei

Transport Hub of Japan and the rest of Asia

Silicon Sea Belt Fukuoka

- **Motivation**
  - **Kyushu has played an important role in semiconductor industry and should change its role in the drastic growth of Silicon Sea Belt countries.**
- **Vision**
  - **Keep the leadership in SoC design and bridge between system design and fabrication technology.**
- **Strategy**
  - **COE of new SoC design technologies**
  - **Human resource for the SoC design industry**
  - **Integration of ventures and IDMs**

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－＞QUBE

Wider Range of Technologies

- Marketing and System Design
- SoC Design
- Fabrication and Testing

Kyushu Semiconductor Cluster Plan

Human Resource Development

College of System LSI Fukuoka and QUBE

System LSI College (2001-)

- 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

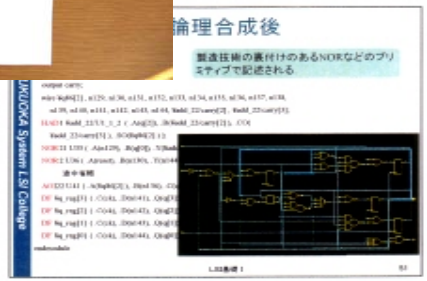
IP Square, Kyuki, Kyushu Electric, Kyushu Mitsumi, JMNet, Seiko Epson, Sony semiconductor Kyushu, TAM, Toppan Print, Toppan Technical Design Center, Hitachi ULSI systems, Logic Research etc.

1,000 design engineers (2001.12～2004.3)

Textbooks and Class Rooms

Lecture

PC for design experiments



Original Texts

New Education Program for Codesign

Experienced Super Engineers

Advanced level
About 10 years' job experience

Master level
About 3 years' job experience

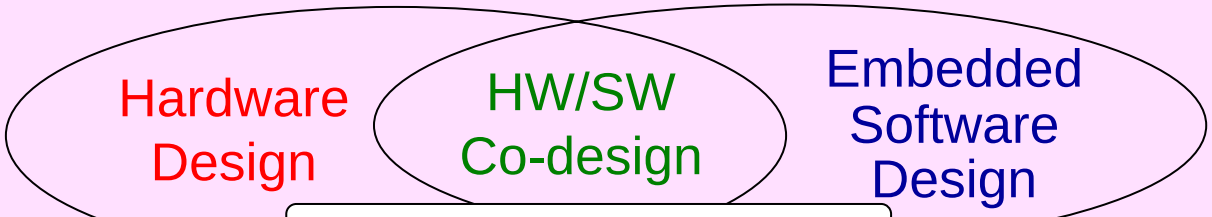
Graduate level
New Employee, graduate student

Introduction level
University student

Q-shu University hardware/software Borderless system design Education program (QUBE)

【Purpose】Educate highly qualified and skilled system LSI design engineers for VLSI design, embedded software design and HW/SW co-design

【Period】2005.7～2010.3 【Goal】Totally 360 engineers



System LSI Design Training Program

Advanced Design Technology Program

Offer Educational Know-how Backup by the Staff

- Cooperated Lecture：Real Embedded Software Development Engineering
- Fukuoka Innovative CLUSTER
- Design Method and Education Division System LSI Research Center
- 21st Century Center of Excellence Program

System LSI Research Center
Graduate School of Information Science and Electrical Engineering
Kyushu University

Shift Upper-level Lectures

- Application/Practice Courses
- Basic Courses

College of System LSI, FUKUOKA

QUBE : Q-shu University hardware/software Borderless system design Education program

【Candidate】 Leading or veteran engineers and researchers in electronic information system companies who need acquisition of high level and advanced technology of system LSI design

【Purpose】 Educate highly qualified and skilled system LSI design engineers for VLSI design, embedded software design and HW/SW co-design

System LSI Design Training Program

【Period】 Design 8 days, Evaluation 2 days
Twice/year

【Completion conditions】
Select 1 lecture among SLD-HW, SLD-SW and SLD-CD
SLD-EV is optional.

SLD : System LSI Design Course」

- SLD-HW : Hardware Design Training
- SLD-SW : Embedded Software Design Training
- SLD-CD : HW/SW Co-design Training

→ SLD-EV : Production Chip Evaluation

Advanced Design Technology Program

【Period】 Lecture 1 day or lecture & exercise ☆ 2 days
Twice/year

【Completion conditions】 Attend 2 lectures including exercise ☆

A-HW : Hardware Design Technology Course
- A-HW1 : Substrate Noise of A/D Mixed Chip
- A-HW2 : Circuit Design Methodology of A/D, D/A ☆
- A-HW3 : EDA Algorithm ☆
- A-HW4 : Signal Integrity Problems ☆
- A-HW5 : RF Circuit Technology ☆
- A-HW6 : Test Design ☆
- A-HW7 : Practical Development Methodology for Large-scaled and High-speed System LSI Design ☆

A-SW : Embedded Software Design Technology Course
- A-SW1 : Embedded Software Development Methodology ☆
- A-SW2 : Software Testing Method ☆
- A-SW3 : Real Time OS and Middleware ☆

A-CD : HW/SW Co-design Technology Course
- A-CD1 : HW/SW Co-design Technology ☆
- A-CD2 : LSI Design by C Language ☆
- A-CD3 : Low Power Design Technology ☆

A-MG : Technology Management Knowledge Course
- A-MG1 : Management of Intellectual Property
- A-MG2 : Management of Technology

Achievements（2）

Real Attendees Count

- 796 persons（2.2 lectures/person）
- Repeaters（attendees in plural years）24 persons（3%）

Establish "Teaching Staff Meeting" by Lecturers

Text Writing & Using in Own Lecture, then Propose Improving

⇒ Improve Curriculum and Text Contents

⇒ Optimize Lecture times/day

～2003：6 hours→2004：8 hours→ 2005：7 hours

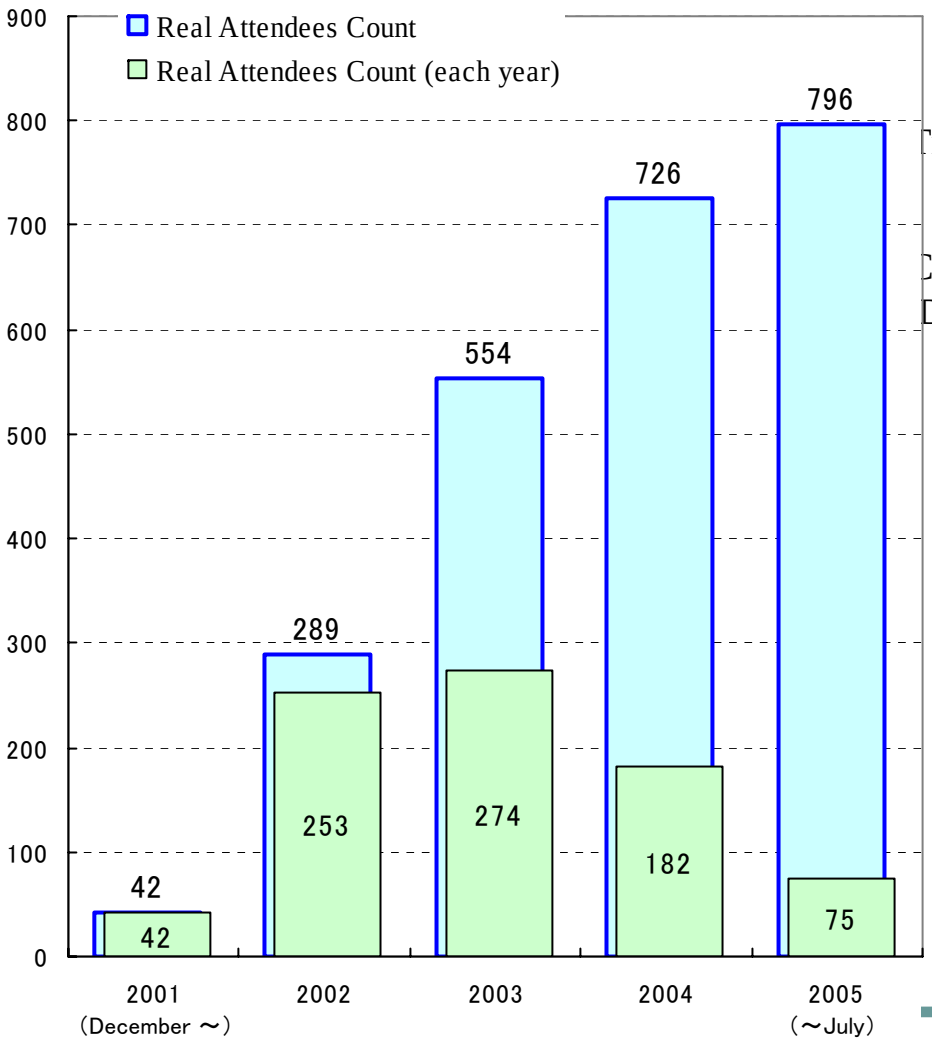
Try to Shorten Lecture Period for Attendees Convenience

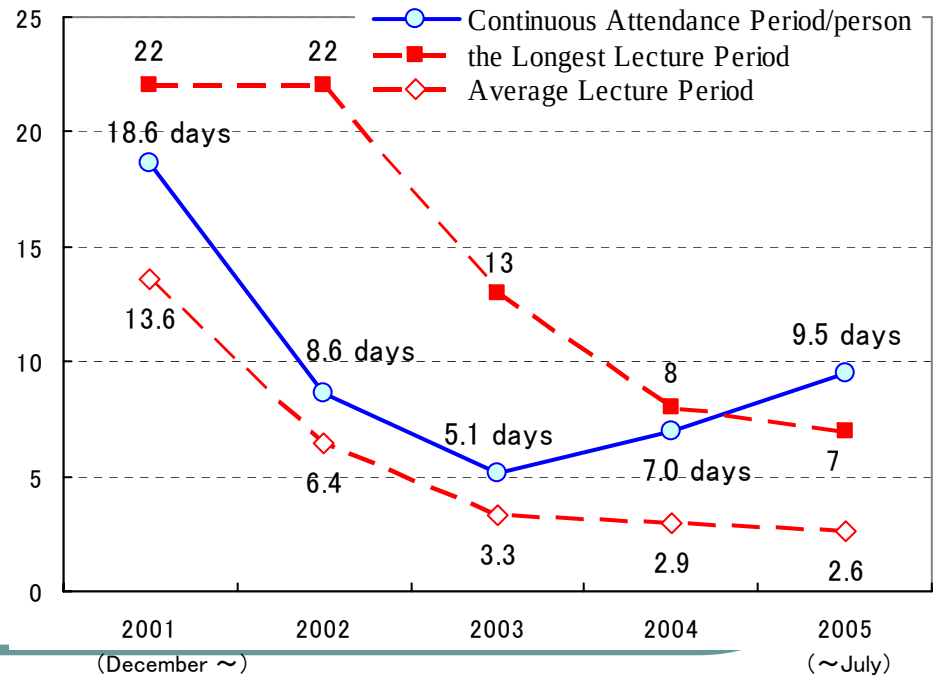
the longest : 22 days ⇒ 7 days

average : 13.6 days ⇒ 2.6 days

Continuous Attendance Period/person

Downward（worst 5.1 days）⇒ Upward（present 9.5 days）



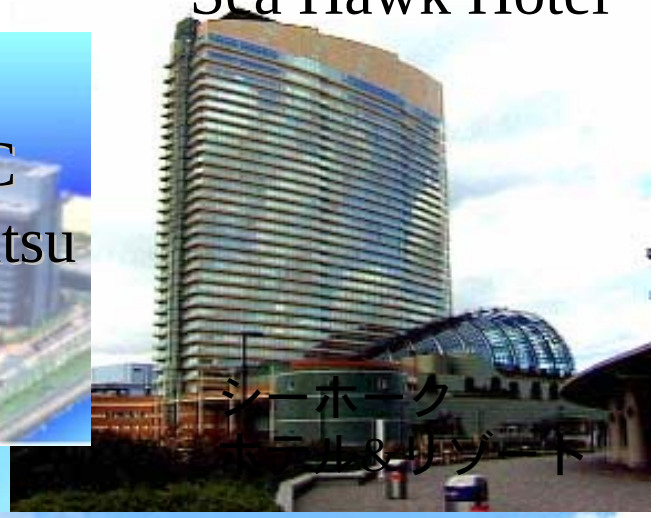


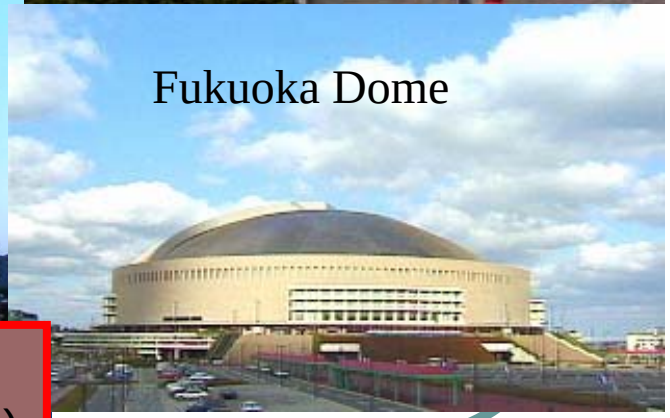
Integration of Industries

System LSI Development Center

Fukuoka Software Research Park

http://www.fukuoka-srp.co.jp/





System LSI Design and Development Center (2004)

Fukuoka System LSI Design and Development Center

(3-8-33 Momochihama Sarawa-ku Fukuoka City)

- Incubation rooms
- Design & verification laboratories for system LSI design ventures
- Fukuoka System LSI College
- Fukuoka Laboratory for Emerging & Enabling Technology of SoC (FLEETS)
- System LSI Research Center, Kyushu University

Fukuoka Venture Market (FVM)

Fukuoka IST
Venture Support Center

System LSI Frontier Formation Project

Subsidy program for system LSI design

Device Implementation Society

Board of Semiconductor connoisseurs (Currently applying for NPO authorization)

IT - Semiconductor Funds (1.5 billion yen scale)

"Genki Fukuoka" Fund
Fund for supporting business start-ups
V Fund Fukuoka

Silicon Sea-Belt Summit in Fukuoka

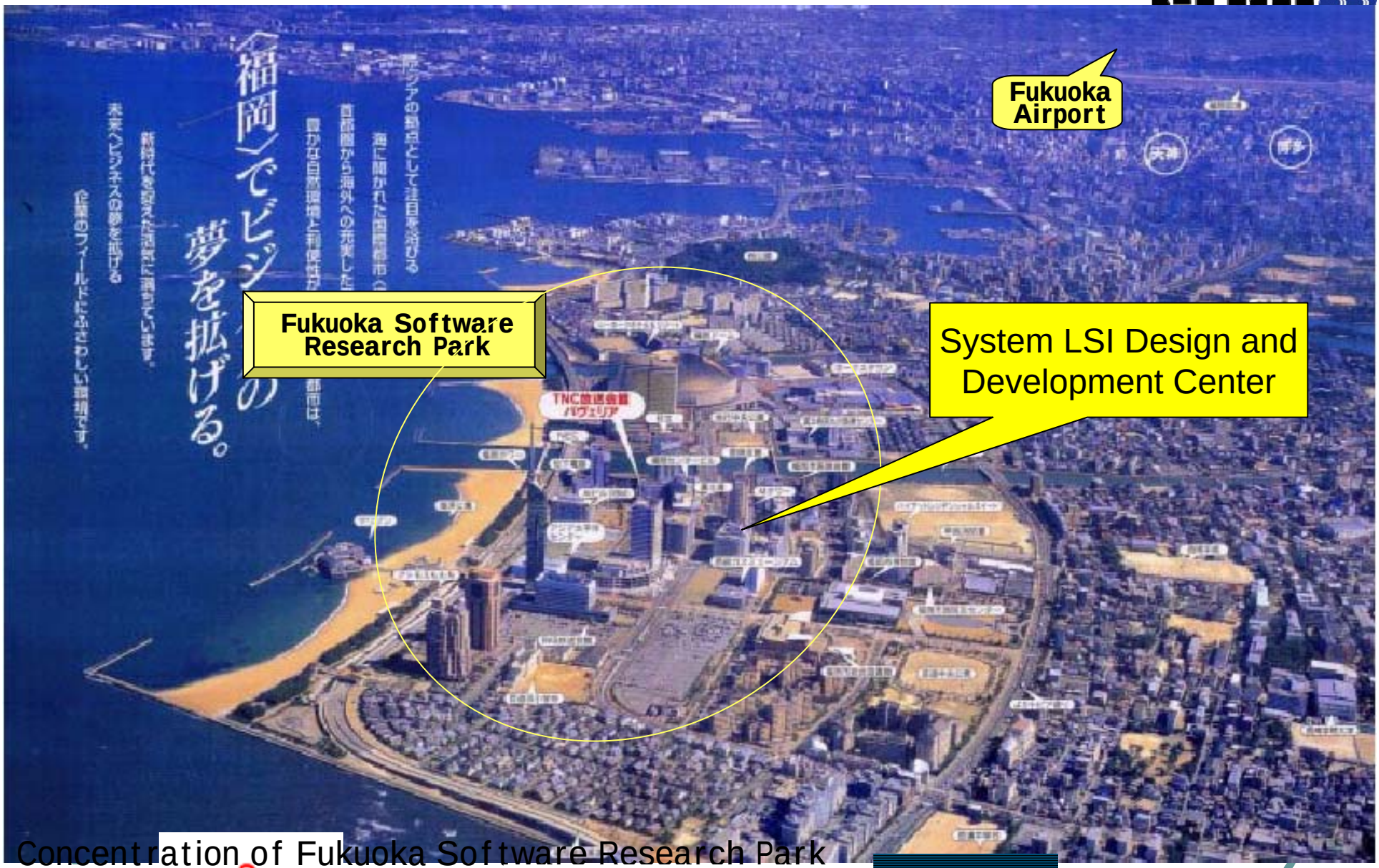
System LSI ventures
Spin-off ventures from large enterprises

Providing one-stop service for system LSI ventures and spin-off ventures from large enterprises
Fukuoka Industry, Science & Technology Foundation (Fukuoka IST)

<Potential of Fukuoka>

- Neighboring the Asian Continent
- Abundance of quality human resources
- Well-developed urban structures
- Strategic projects in collaboration among industry, academia and government
- Integration of wide range of industries
- Integration of LSI related companies

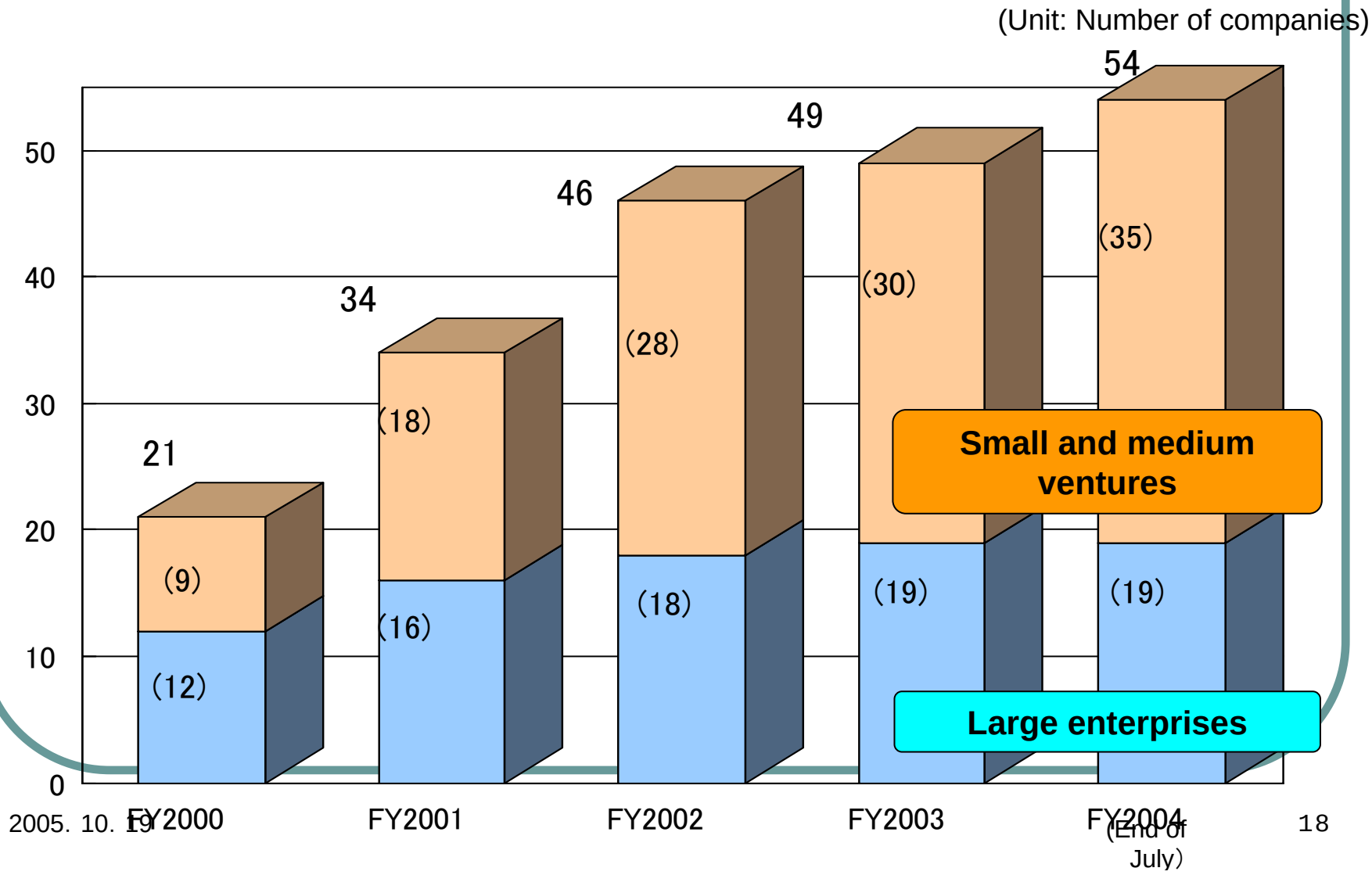
《Contact》
Fukuoka Industry, Science & Technology Foundation (Fukuoka IST) System LSI Section
Acros Fukuoka Nishi Office 9F, 1-1-1, Tenjin, Chuo-ku, Fukuoka 810-0001 JAPAN
TEL: +81-92-725-2781 FAX: +81-92-725-2786
URL http://www.ist.or.jp/lsi/
E-mail lsi-center@ist.or.jp



Concentration of Fukuoka Software Research Park

NEC FUJITSU HITACHI Panasonic SONY IBM HOYA

Small and medium ventures related to LSI design and verification continue to gather (within Fukuoka)



Research Activities

System LSI center of Kyushu Univ.
CLUSS Project

System LSI Research Center

System LSI Research Center (SLRC) was established in 2001 to be a COE of System LSI design technologies. SLRC has played an important role in Silicon Sea Belt Fukuoka project through research activities in Innovative Cluster Creation Project and education in System LSI College. SLRC is also promoting IC card project in Kyushu University. A satellite campus was opened in Momochi-hama in 2004, where many LSI design industries are located.

System LSI Research Center

Kyushu University
System LSI
Research Center

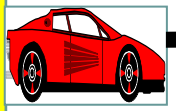
From needs in Society, find the solutions using System LSIs.

VDEC University of Tokyo
Test Chip Fab. Service

MOSIS (USA), CIC (Taiwan),
IDEC (Korea), Euro Chip

Requirement from Society

- Consumer Electronics
- Game
- Communication
- Automobile
- Air Lines
- Rail Road
- E-Commerce
- E-government
- Medical Application
- Vending Machines
- Robots
- Life Lines
- Education



System LSI Design

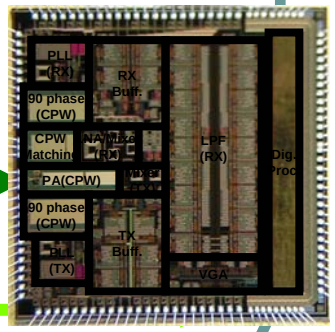
Software

VLSI Design

Software + VLSI

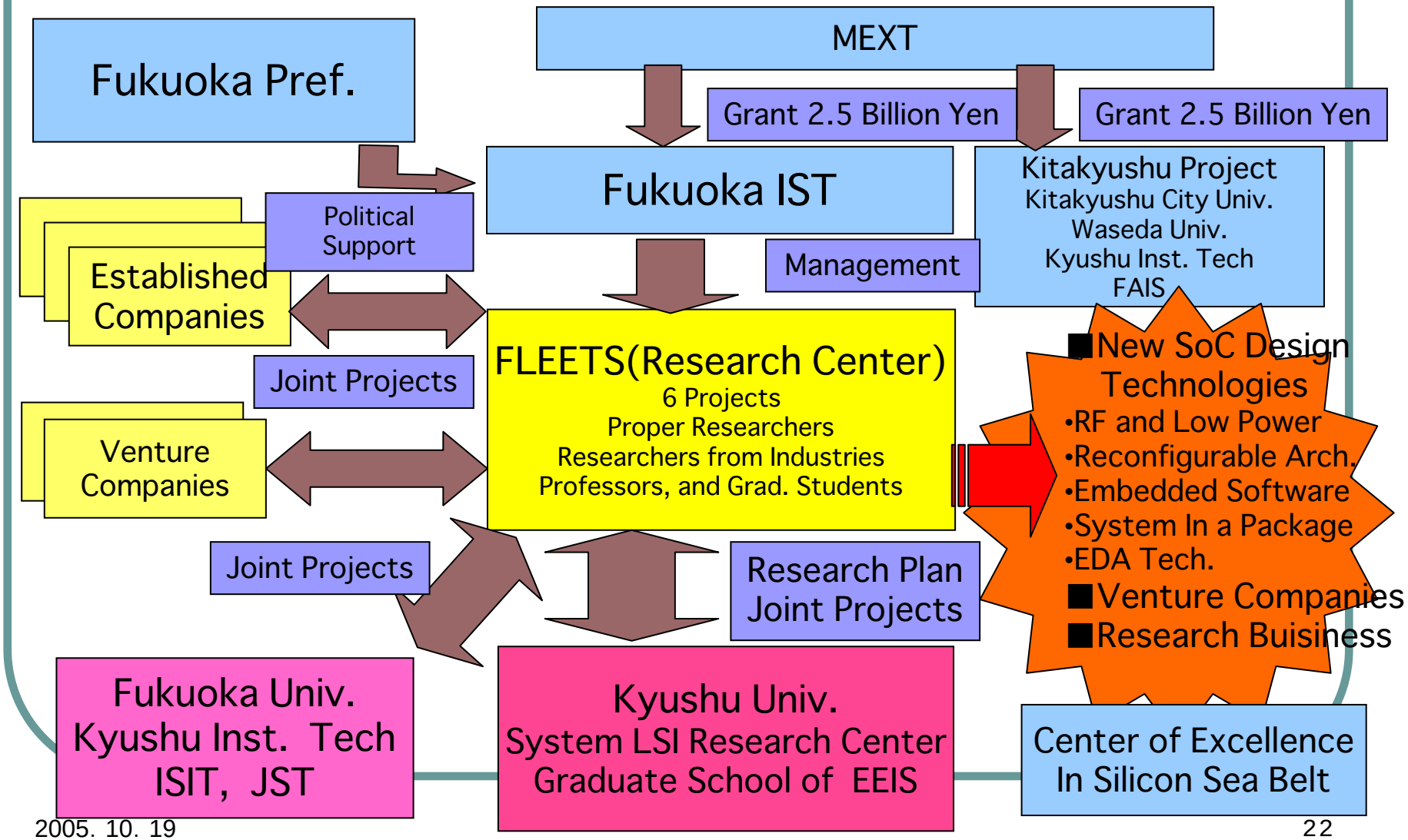
Fabrication

System LSI



Tohoku Univ. and
Hiroshima Univ.

CLUSS:
Innovative CLUster for Silicon Sea Belt



Goals of CLUSS

- **To be a Front Runner of Core Technologies**
  - **Embedded Software, EDA, RF Systems, SiP JISSO, Reconfigurable Architecture, Test technologies, Low Energy System Design and IPs**
- **Launch Design Industries in Fukuoka**
  - **SoC Design, SiP, IPs, New SoC Architecture, Embedded Software, and Research Business**
- **Establish a Research Institute as COE**
  - **FLEETS**

Technological Strategy

- Prepare various design and implementation flows for Systems (SoC and SiP)
  - Variety of products
    - # of Products (1K to 100M)
    - Variety of technologies (Memory, RF, Sensors, Optics)
    - Turn around time and short life of products
  - Various ways of supply of functionality
    - Known good die (Memories, Processors)
    - IP cores in various design levels
    - Configuration data for reconfigurable circuits
    - Embedded software
  - Trade-off among Cost, Performance and Energy
  - Embedded Software, Reconfigurable Computing and System in Package

Research Projects in CLUSS

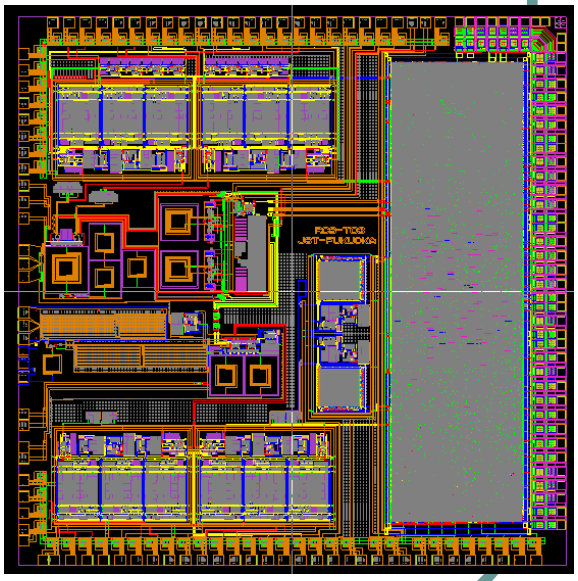
- Design Method for Low Energy Mobile System LSIs
  - (Haruich Kanaya, SLRC Kyushu Univ.)
- Next Generation System LSI Architecture
  - (Kazuaki Murakami, SLRC Kyushu Univ.)
- Design Methodology for SiP (System in a Package) Module
  - (Hajime Tomokage, Fukuoka Univ.)
- EDA Technology for The Next Generation
  - (Yusuke Matsunaga, SLRC Kyushu Univ.)
- Design Methodology for Embedded Software
  - (Akira Fukuda, Kyushu Univ.)
- Application Specific SoC Design
  - (Satoshi Goto, Waseda Univ. Joint Project with Kitakyushu)

Design Method for Low Energy Mobile System LSIs

Prof. Kanaya and Prof. Yasuura (Kyushu Univ.)

SoC Design Technologies for Mobile Systems

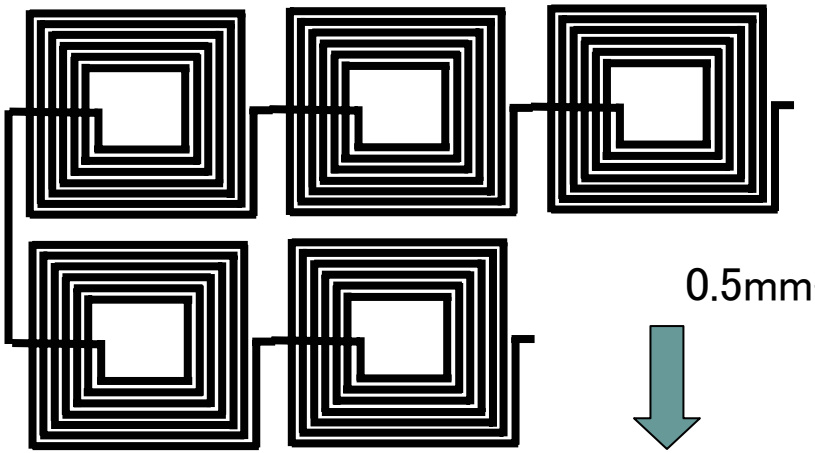
- 1 Chip CMOS Solution for RF Circuit
  - CPW Circuits on CMOS
  - SoC and SiP Solutions
- Low Power Design and System Architecture for communication
- Coding and Cryptography
- Wireless Power Supply



Wireless LAN(0.25 μm CMOS)
IEEE802.11b

Reduction of Area by CPW

Spiral Inductor

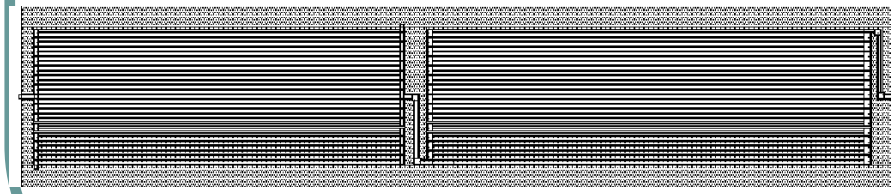


0.5mm^2

Matching
Fixed Shape
Large Area

Smaller Size for Higher Frequency

CPW Matching Circuit（2.4GHz）



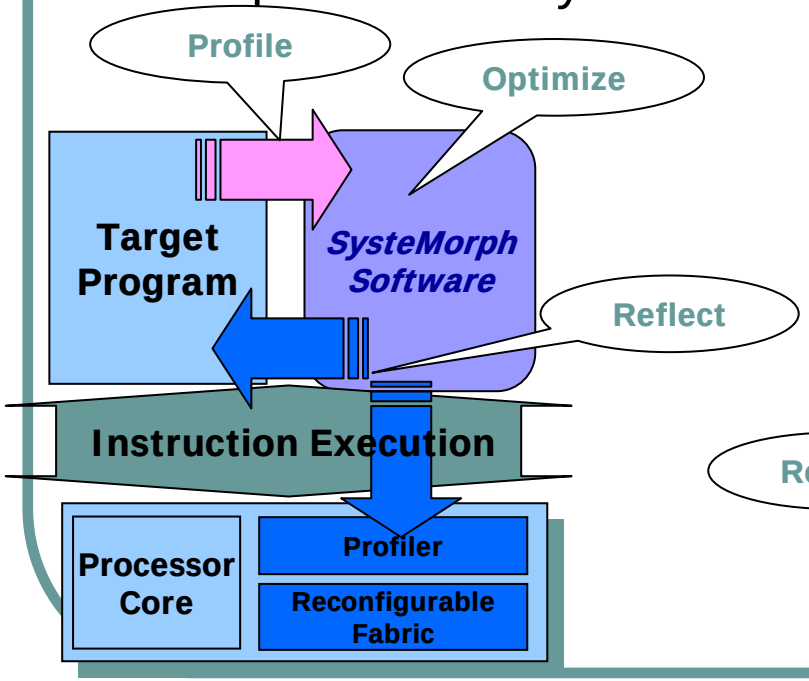
0.3mm^2

Matching and Filtering
Freedom of Shape
Small Area

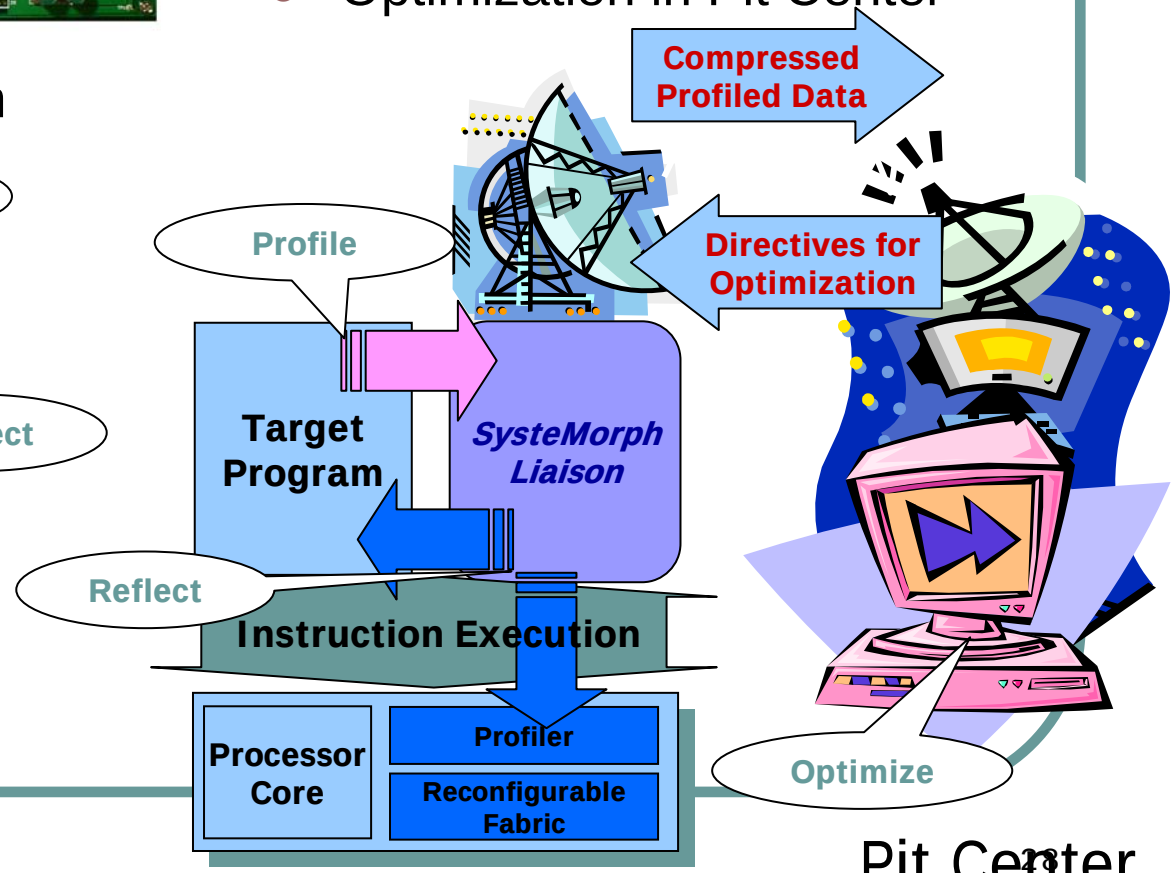
Dynamic Reconfiguration:SyteMorph

- Dynamic Profiling
- Dynamic HW Synthesis
- Dynamic SW Rewriting

- Self Optimization System



- Optimization in Pit Center

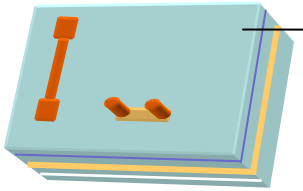


Design System for SiP Modules

Substrate Design

・Library of Substrate Parameters

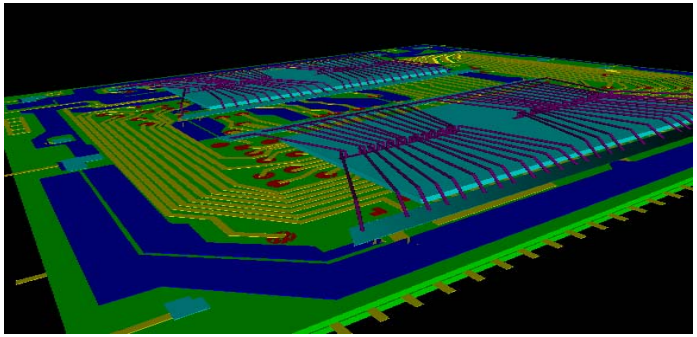
System Design

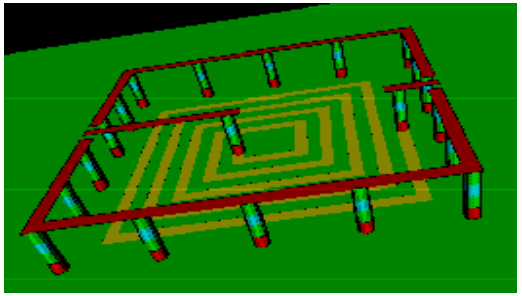


Laminated bare Chips

Floor Planer

・3D Placement and Routing





I/O GERBER Format

Prof. Tomokage
(Fukuoka Univ.)

Simulator

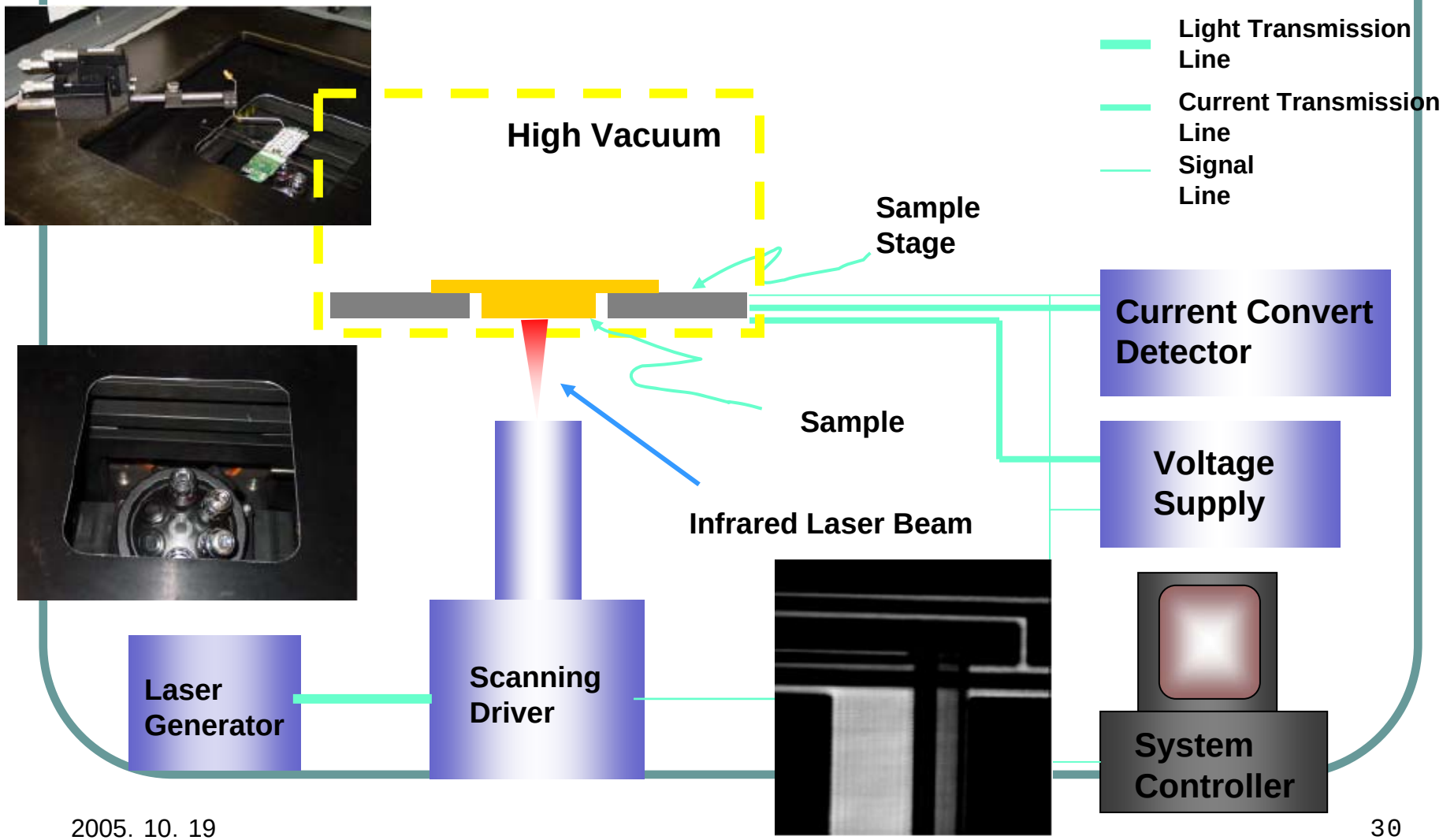
・Connection

・HF Characteristics

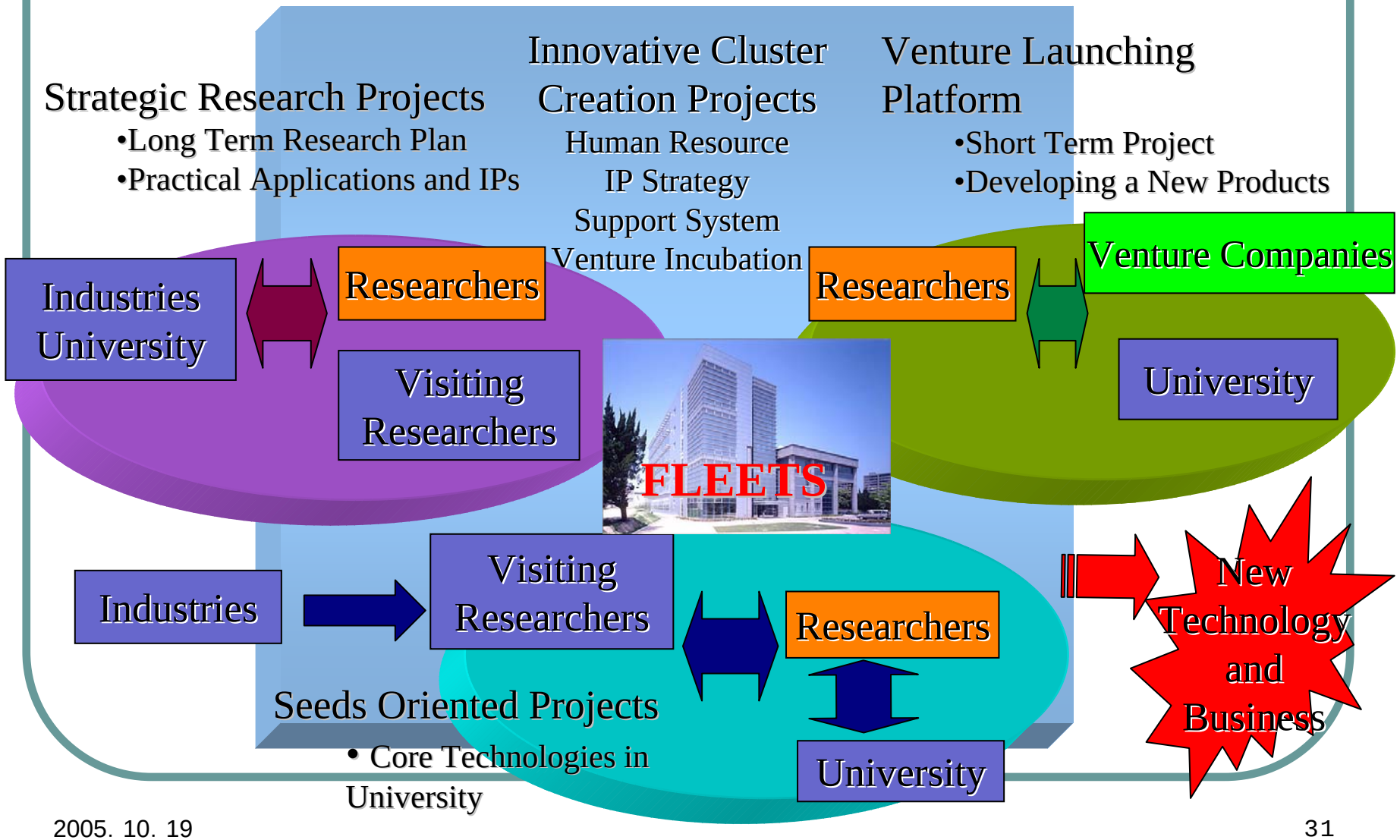
・Thermal Analysis

Final Design Data

SCHEMATIC DIAGRAM OF OBIRCH
(Optical Beam Induced Resistance Change Method)



Flexible Organization of Projects



Conclusions

- Silicon Sea Belt is a center of SoC Industrial activities. Fukuoka will be a center of design.
- We are establishing new relationships among researchers and engineers for mutual collaboration in SSB countries.
- Concept making on design flow and methodology will be a key of the next step-ups in SSB countries.