Cybersecurity and Collaborative Research Projects

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KYUSHU UNIVERSITY
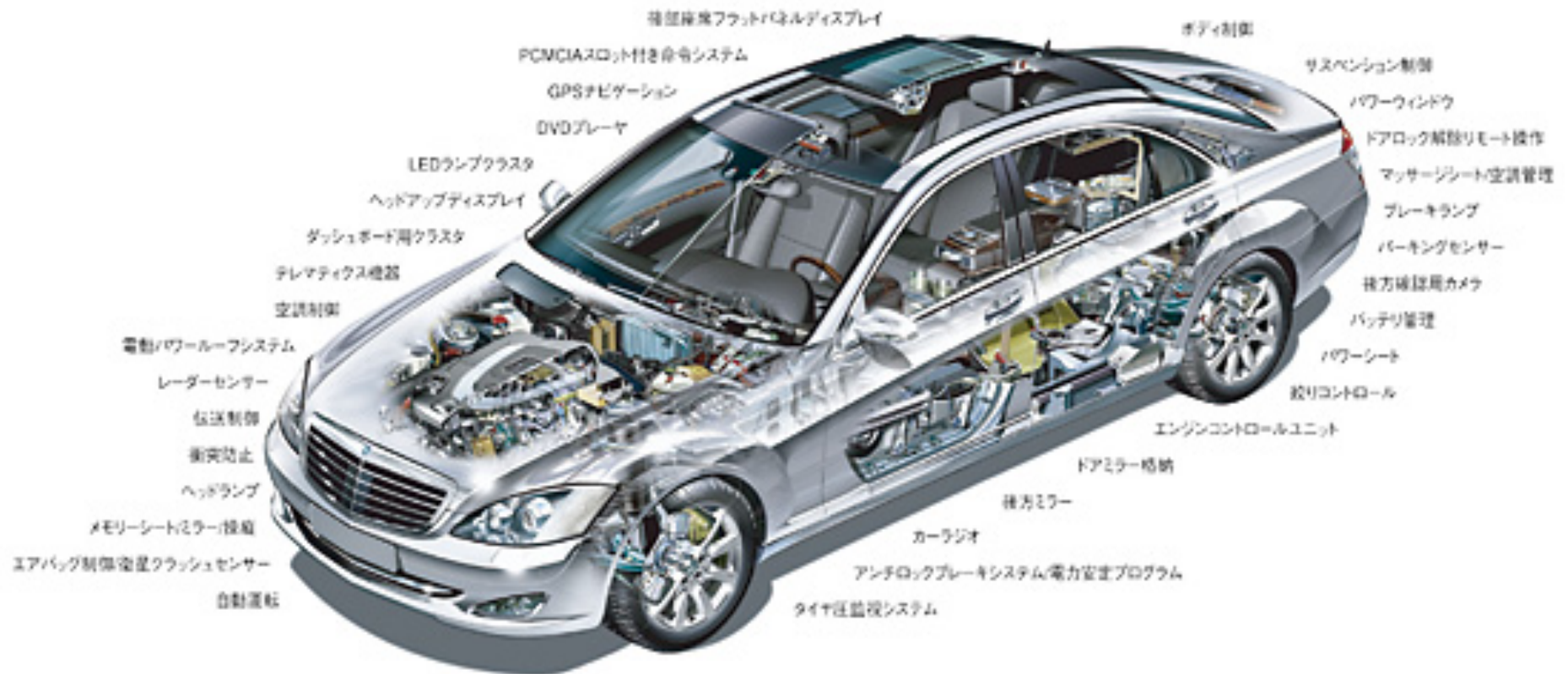
KYUSHU UNIVERSITY 2011
100th Anniversary

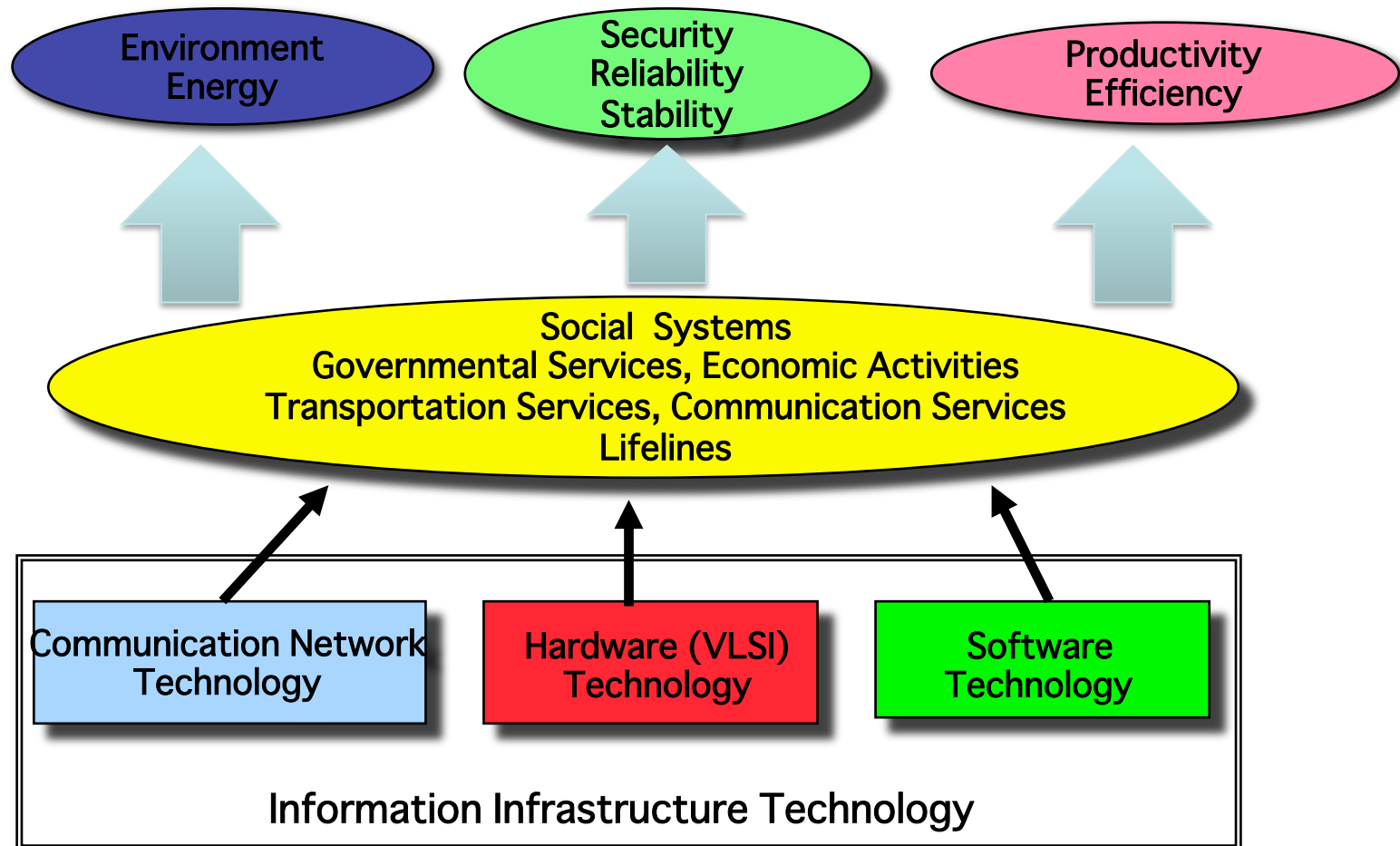# Systems become more complicated and hard to control.

Our Society Depends on Information Infrastructure Technologies

# Social Information Infrastructure

- Social Information Infrastructure (SII) is a Basic Infrastructure of the Modern Society.
    - SII is related various our daily activities.
        - Life: Transportation System, Health Care System, Life-line Systems
        - Property: e-Commerce, e-Banking, e-Money
        - Privacy: Authentication System, Communication System
    - SII should be dependable for users.
        - **Secure and reliable operation**
        - Stable operation in many years
        - Failure free operation with allowance of some performance degradation
        - Easy to maintenance
        - Gradual and sustainable improvements

Dependability is the 4-th Value of ICT

- **Cost of Systems**

- **Performance of Systems**

- **Energy Consumption**

- **Dependability: Reliability and Security**

SII as an Operating System of Society
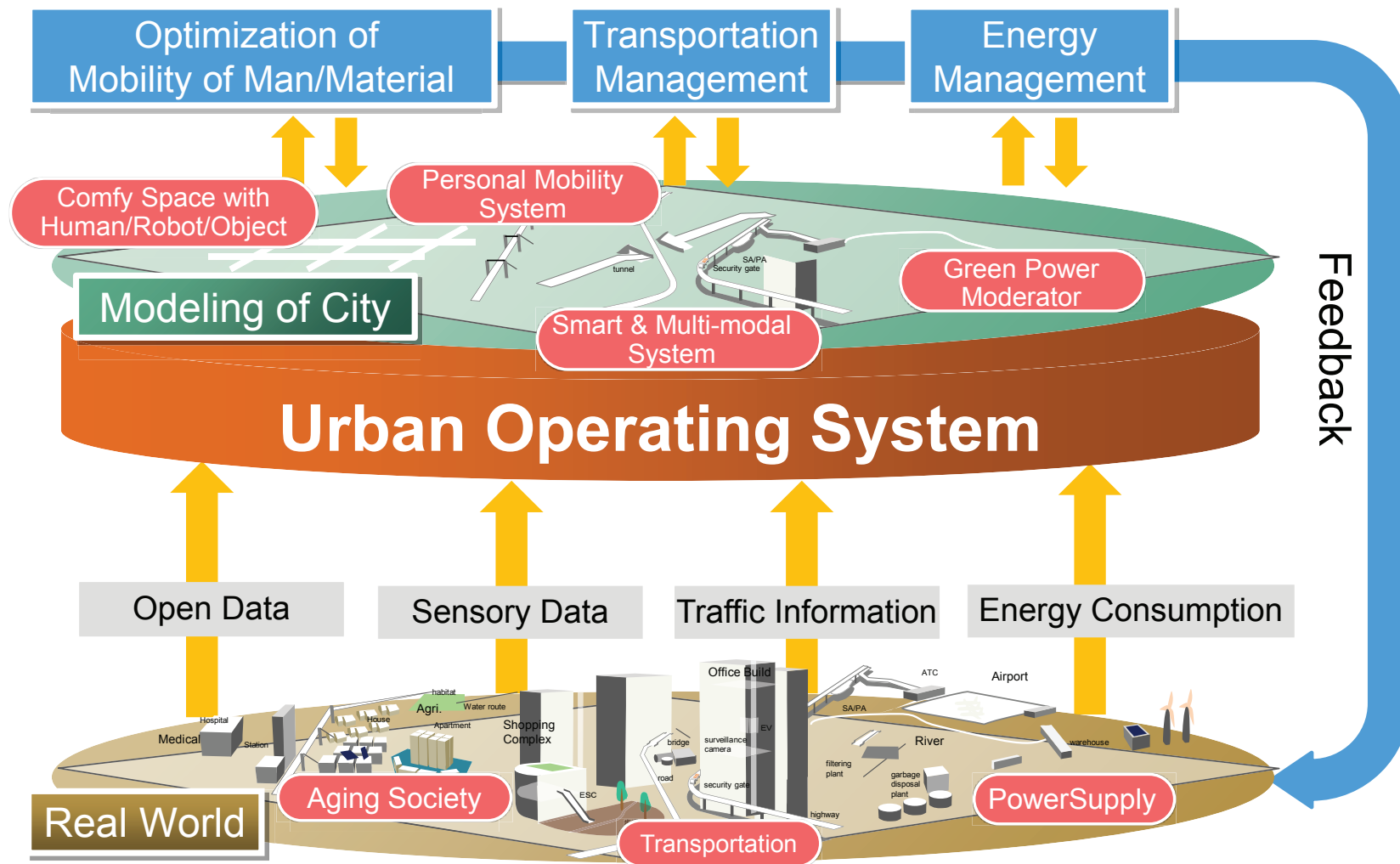
Threats of Dependability in IIS

Safety from Natural Disasters

Physical Malfunctions of Devices

Variation of Natural Conditions

Soft Errors by Particles (Neutrons etc.)

Cross Talks of Communication Channels

Incomplete Specification and Misunderstanding of Semantics

Mismatches System Specifications and Social Rules

Errors of Operators

Design Bugs in HW and SW

Incomplete Testing and Verification

Terrorism and Military Attacks

Theft of Information and Devices

Virus, Worms and Hacking

Malicious Attacks in System Design, Fabrication and Test

Unintentional Attacks

- Natural Phenomena
- Human Errors
- Malicious Attacks

Threats of Security

- **Terrorism and Military Attacks**
- **Theft of Information and Devices**
- **Virus, Worms and Hacking**
- **Malicious Attacks**

  in System Design, Fabrication and Test
- **Unintentional Attacks**

Possible Threats : Automobile Systems

	Natural Threats	Human Errors	Attack
Plan	•Misunderstanding of Assumption of Usage	•Bug in Specification	•Theft of Plan
Design	•Design Errors	•Design Bugs, Errors in Assumptions	•Theft of Design
Fabrication	•Fabrication Errors	•Errors in Fabrication	•Illegal Operations and Parts
Test	•Intermittent Faults •Coverage of Environments	•Errors in Test	•Illegal Operations
Distribution	•Variation in Environments	•Mixture of Defectives and buggy SW	•Mixture of Counterfeits
Operation	•Ageing and Maintenance •Accidents	•Errors of Drivers and Maintenance	•Attack by ICT
Abandonment		•Miss-Arrangement in Replacement	•Theft of Logged Information

Difficulty of Security Maintenance

- Complexity of Systems
  - No Information on Total systems
  - Connections of Various Systems
  - Hard to Classify Attacks, Errors and Natural Faults

- Rapid Improvements of Attacking Techniques
  - Wars in Cyber Spaces
  - Crackers and New Crimes

- Mismatches of Social Systems and ICT
  - Unfamiliarity of Users of ICT
  - Walls of Laws and Privacy Protections
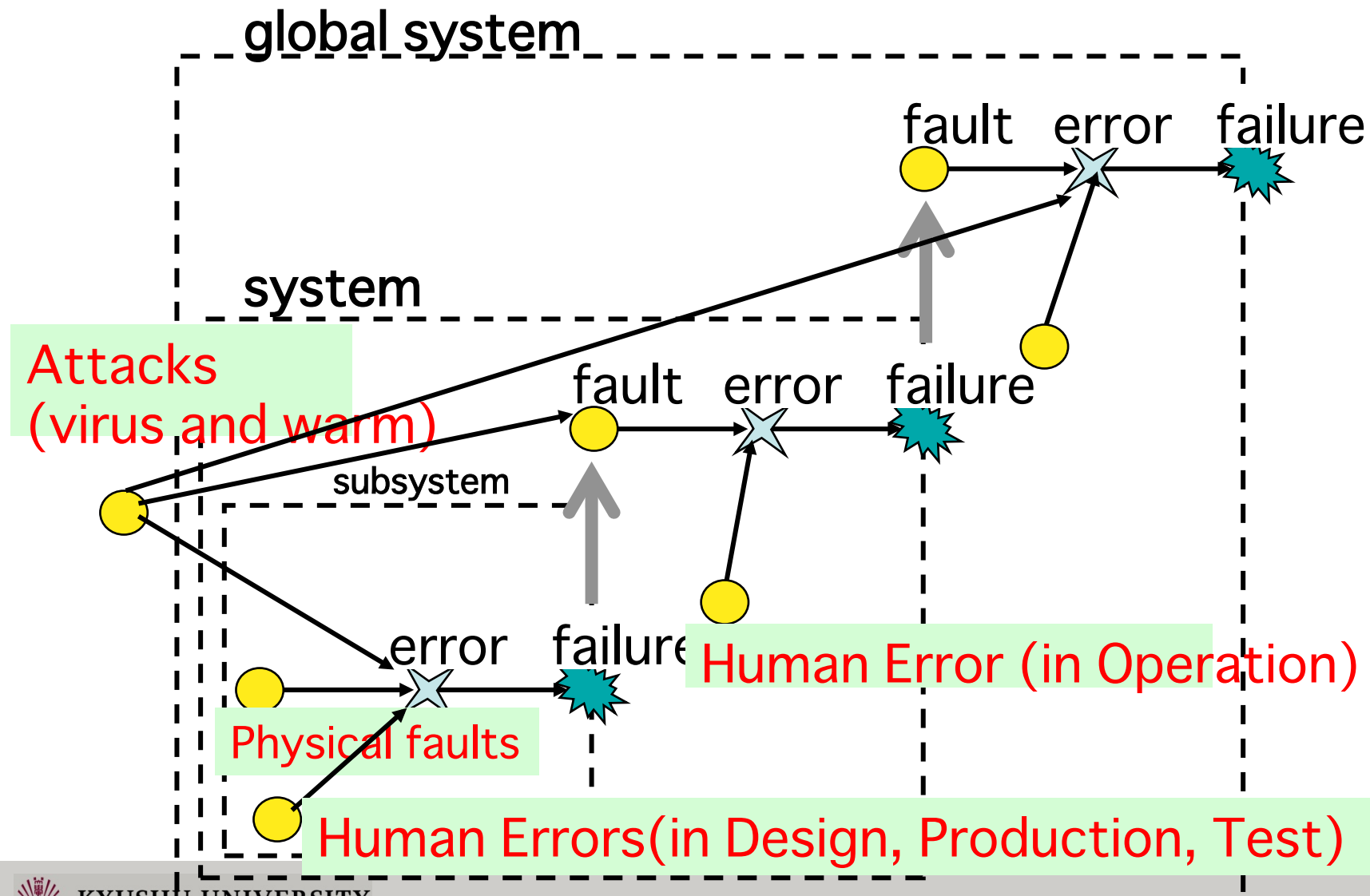
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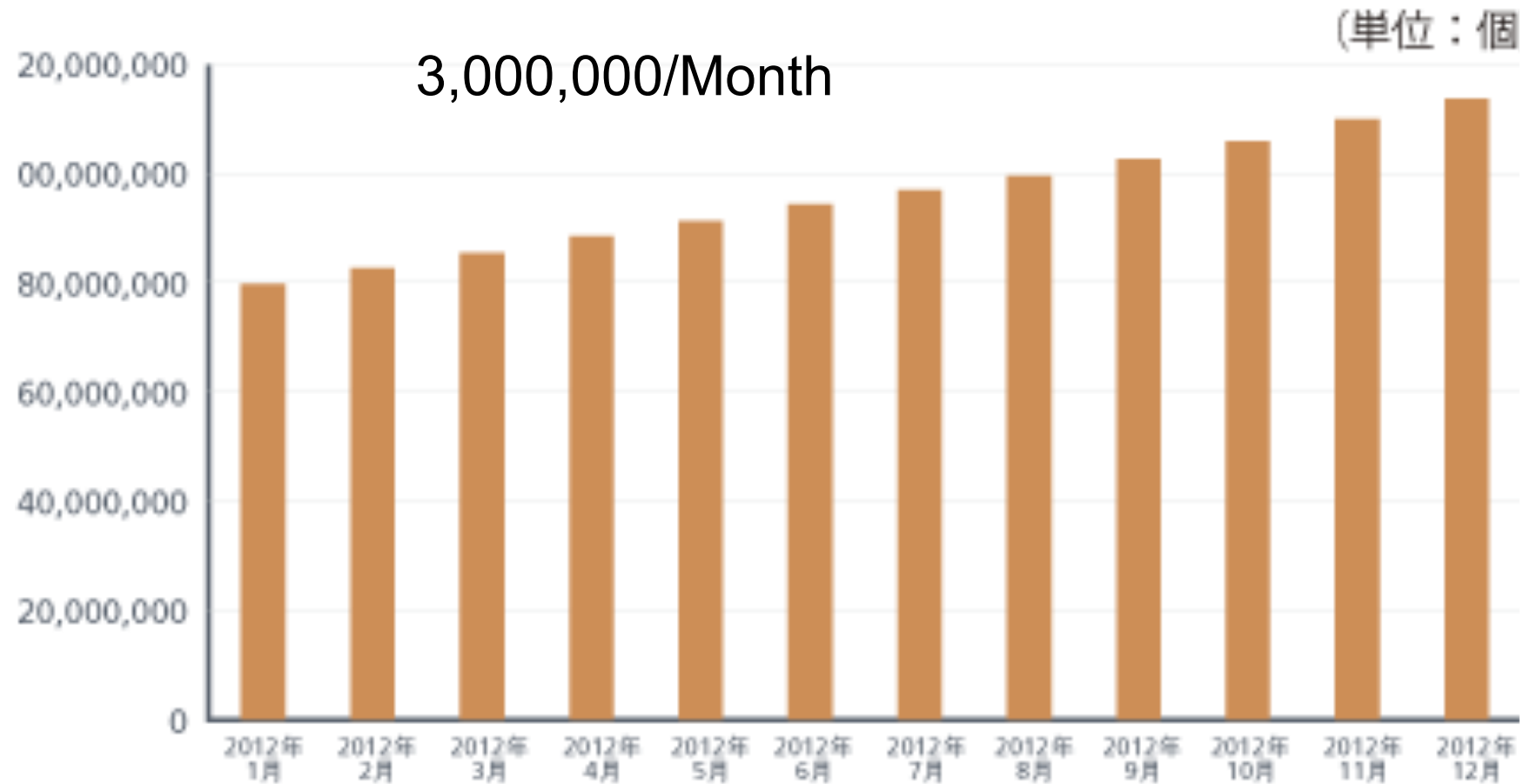# Increase of Malwares

3,000,000/Month

Source: McAfee

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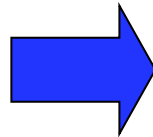 - Walls of Laws and Privacy Protections

Problem of e-Money

How to handle Credit, Value and Property on ICT.
1,000$ on a 10$ Device.

2,000 years

1,000 years

Paper Bill (10th C)

Metal Coins
(before BC 10th C)
- Value: Gold or Silver
- Conservation: Metals

- Value: Printed information guaranteed by governments and/or banks.
- Conservation: Paper
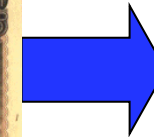
Electric Money
Bit Coin
(21st C)

- Value: Digital Information.
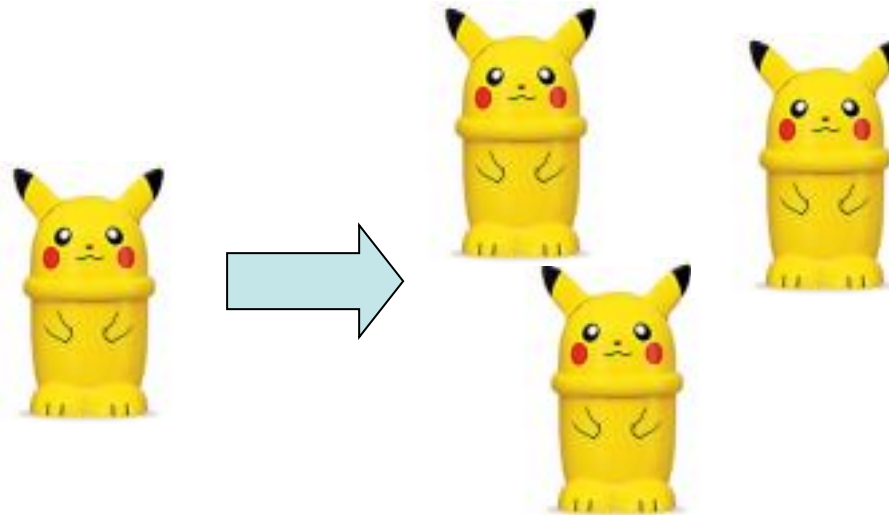- Conservation: Digital Information?

Kids Knew the Problems

Can we securely treat "values" as copy-free digital information?

In the game world
- Illegal copy of PIKACHU
- Virtual money in online games

Technologies for Security in Cyber Space
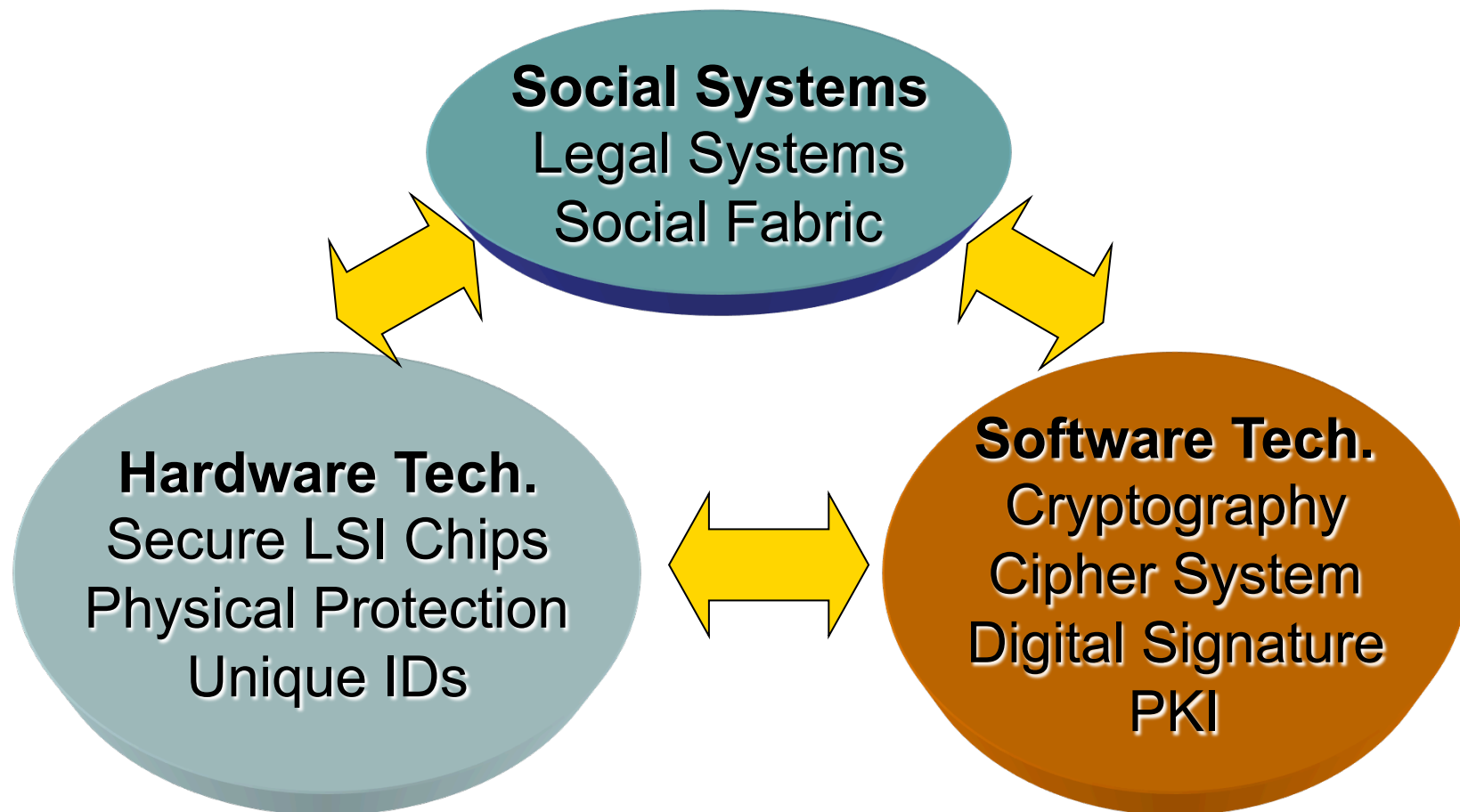
Researches on Cybersecurity

Cryptography
- Public key system (RSA, Elliptic Curve etc.)
- Design and Analysis Techniques
- Applications and Standardization

Secure Information System
- Protection from Attacks (Fire walls, Network Structure)

Security in Communication
- Secure Protocols

Security for Software
- Protections from virus and warms

Security for Hardware
- Anti-tampering
- Protection from Side Channel Attack
- Quantum telecommunication

Collaborations are Required

Social System and Structure
- Social System Design, Regulation by Laws

Service and Operation
- Communication Service, Computing and Data Service

Product and Work
- Mobile Devices, Sensors, Wireless Systems, Software,
- Data Contents, Cryptography

Design and Production Technology
- Design Technology, Software Engineering,
- Device Manufacturing

Natural Phenomenon and Law
- Physics, Information Theory, Mathematics

Politician
Social Scientists
Ethics
Government
Business
Economics
Telecom.
Industries
Electronics
Software
VLSI
Manufacturing
Natural Scientists
Mathematician

Collaboration with Various Sectors

- Academic Sectors

- Governments

- Business and Industrial Sectors

- Social Infrastructure Operators

- Lawyers and Public Security Sectors

- Educational Sectors

- International Organizations

- Military

Backgrounds

- Japan initiated "National Cybersecurity Strategy" program and is committed to lead world as "Cybersecurity Nation".
  - Cybersecurity Basic Act (Nov.12, 2014)
- However, the number of cybersecurity professional is dangerously lacking, and Japanese universities have been offering very few programs and producing very few professionals.
- Kyushu University (KU) is committed to develop comprehensive cybersecurity research and education program.
- KU started BYOD (Bring Your Own Device) system for all undergraduate students from 2013. Cybersecurity education is urgent for all students.

Kyushu University Cybersecurity Center

Body of the Center

– Research Institute for Information Technology

– Graduate School of Information Science and Electrical Engineering

– The Faculty of Arts and Science

– Institute for Mathematics for Industry

– The Faculties of law and Economics

Collaborative Internal Organizations

– Information Infrastructure Initiative, Innovation Center for Education Resources, KU Hospital Medical Information Center
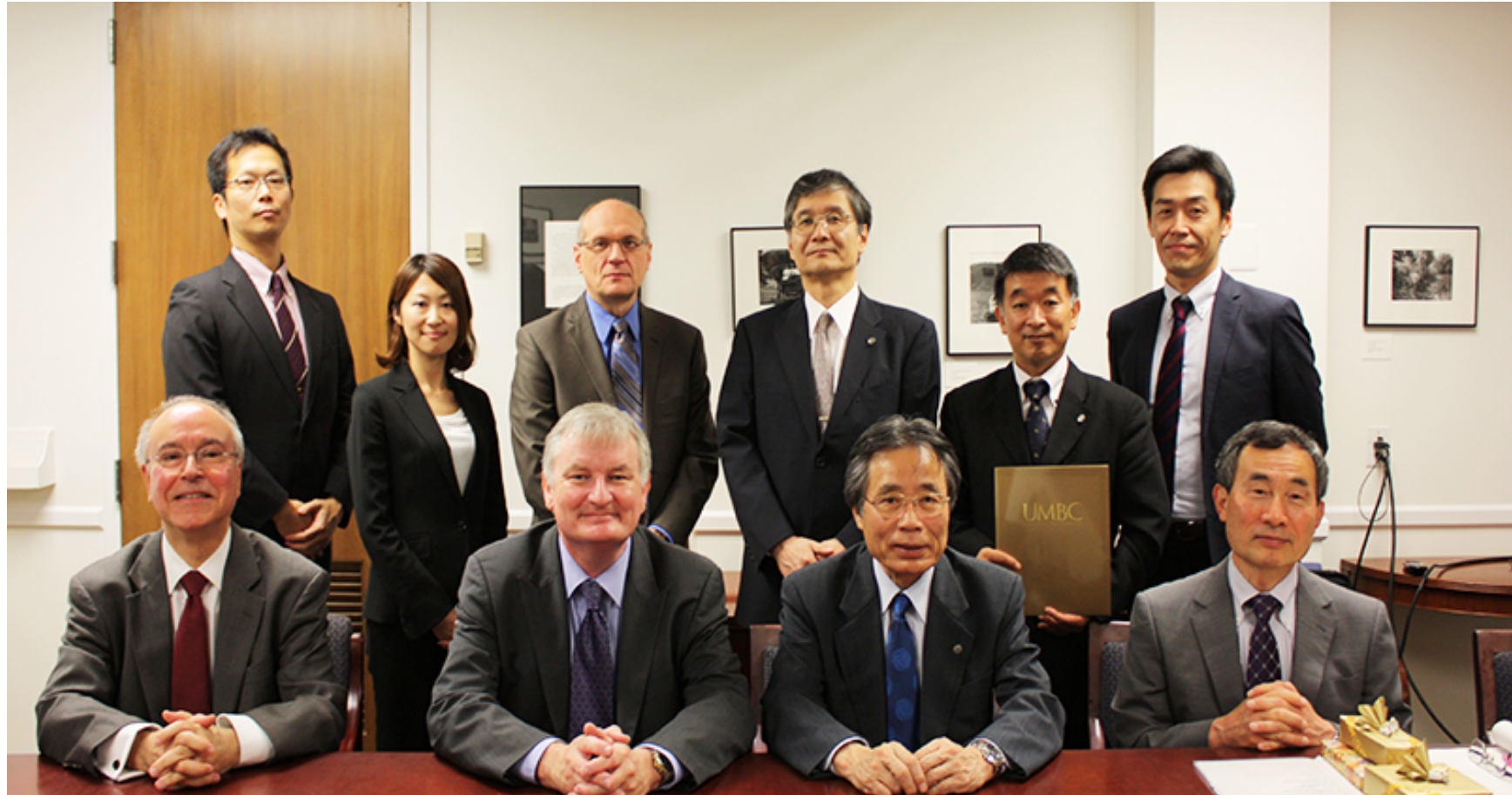
Collaboration Partner

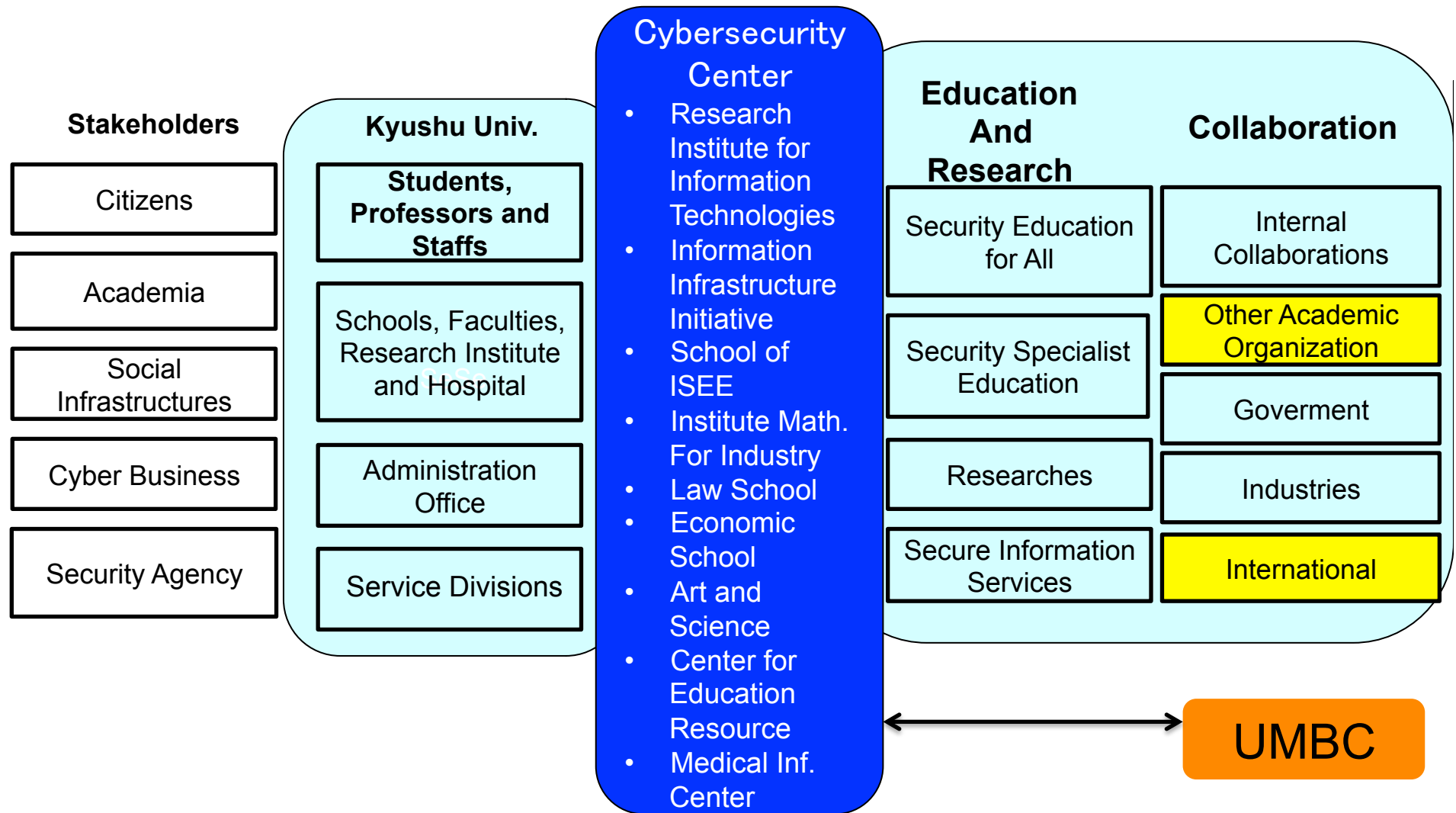– University of Maryland Baltimore County

Industrial Collaborators

– Companies in telecom, power supply, data business area.

UMBC: Our First and Promising Partner

Collaboration of Cybersecurity Center

Stakeholders
- Citizens
- Academia
- Social Infrastructures
- Cyber Business
- Security Agency

Kyushu Univ.
- Students, Professors and Staffs
- Schools, Faculties, Research Institute and Hospital
- Administration Office
- Service Divisions

Cybersecurity Center
- Research Institute for Information Technologies
- Information Infrastructure Initiative
- School of ISEE
- Institute Math. For Industry
- Law School
- Economic School
- Art and Science
- Center for Education Resource
- Medical Inf. Center

Education And Research
- Security Education for All
- Security Specialist Education
- Researches
- Secure Information Services

Collaboration
- Internal Collaborations
- Other Academic Organization
- Goverment
- Industries
- International

UMBC

Model of Cybersecurity Education

- Cybersecurity for All (2014-)
    - Define basic literacy of cybersecurity for all citizens
    - Teach all freshmen about basic cybersecurity literacy
    - Cybersecurity literacy as a core curriculum for all students

- Cybersecurity for Professionals(2015-)
    - Professional course for cybersecurity talents
    - Undergraduate and Graduate courses in Computer Science, Electrical Engineering and Mathematics
    - Starting from as minor course with certification
    - Leader education in School of International Arts and Science

- Advanced Research and Education on Cybersecurity
    - Involving social scientists and researchers in various fields

Collaboration with Maryland University

Collaboration between UMS and KU

Kyushu University

University of Maryland

1. Cyber Security: Education and Research
- Exchange of Students, Teaching Staffs and Researchers
- Sharing Teaching environment and Materials
- On-Line Cause Exchange
- Research Exchanges

2. Data Science: for Life Science, Engineering, Social Sciences, Natural Sciences
- Collaborative Researches
- Exchange of students

3. Creation of Innovation: Collaboration with Industries in U.S. and Japan
- Development of New Education for Innovation
- Social Experiments in Practical Fields

Conclusions

- ICT is changing the world.
- Cybersecurity has become risk of serious and global scale, and has become national security issue.
- It is necessary to develop security technology from application/device level to network/national system level.
- Cybersecurity research and education must be done by multi-aspect and multi-group efforts.

Cybersecurity as
a basic and innovative technology
to keep peace and safety of the future world!