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# Knowledge Emergence Infrastructure by Convergence of Real World and IT

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Contents



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# 1-1. Global Issues

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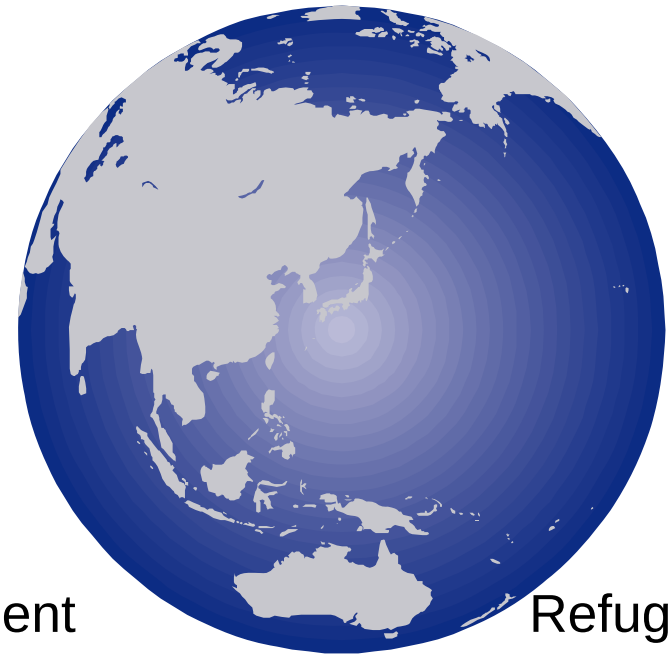
## 21 global issues grappled by the United Nations

http://www.un.org/en/globalissues/

Atomic Energy
Environment
AIDS
Demining
Peace and Security
Food
Climate Change
Africa
Human Rights
International Raw
Woman
Governance
Humanitarian and Disaster Relief Assistance
Children
Decolonization
Ageing
Agriculture
Person with Disability
Disarmament
Refugees
Development Cooperation



# 1-2. Reasonable Approach to Tackle Global Issues

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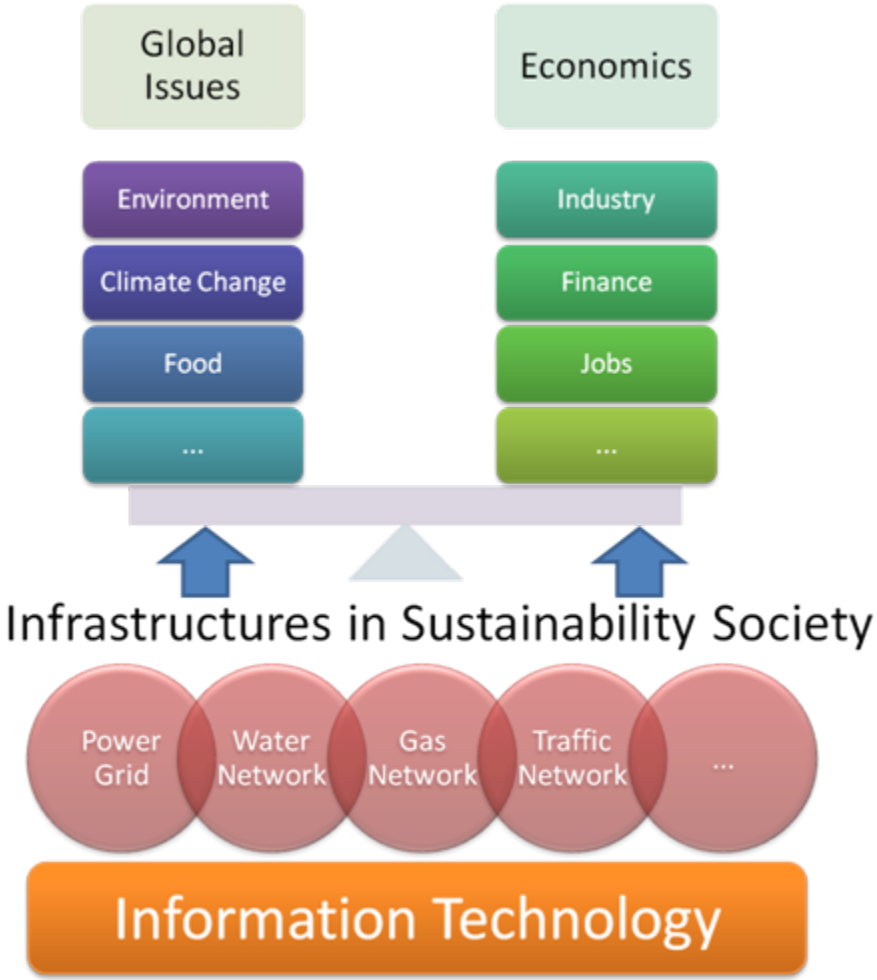
- It is important to improve efficiency of activity in daily life to harmonize issues.
- Social Infrastructures that support daily life should be “globally” optimized.
- IT plays a roll for a infrastructure of infrastructures.



# 1-2. Reasonable Approach to Tackle Global Issues

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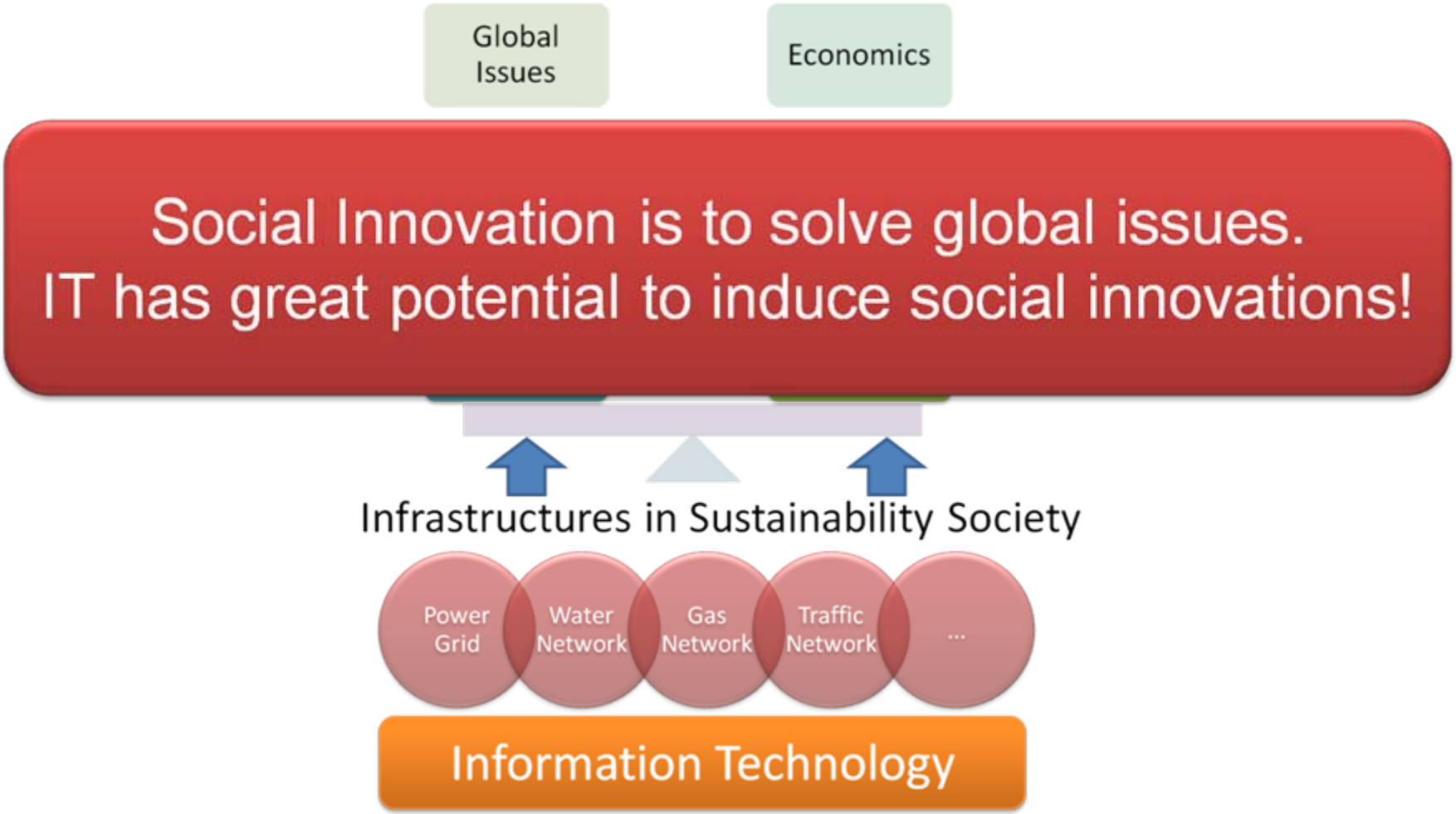

# 1-3. Upcoming Information-Explosion Era

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## Produced RFID (Japan)

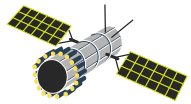
1.8 Billion
(in FY 2012)

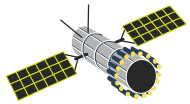
1.6 million (FY1999)

32 million (FY2006)

**Items become traceable**

## Shipped GPS cell phones (W/W)





2.8 Billion

in FY 2007-2012

**Behavior become observable**

Reference：Yano Research, Parks Associates

Newly evolutional services will be available by storing and using massive amount of real world data

# 1-4. The Cloud yet to Come

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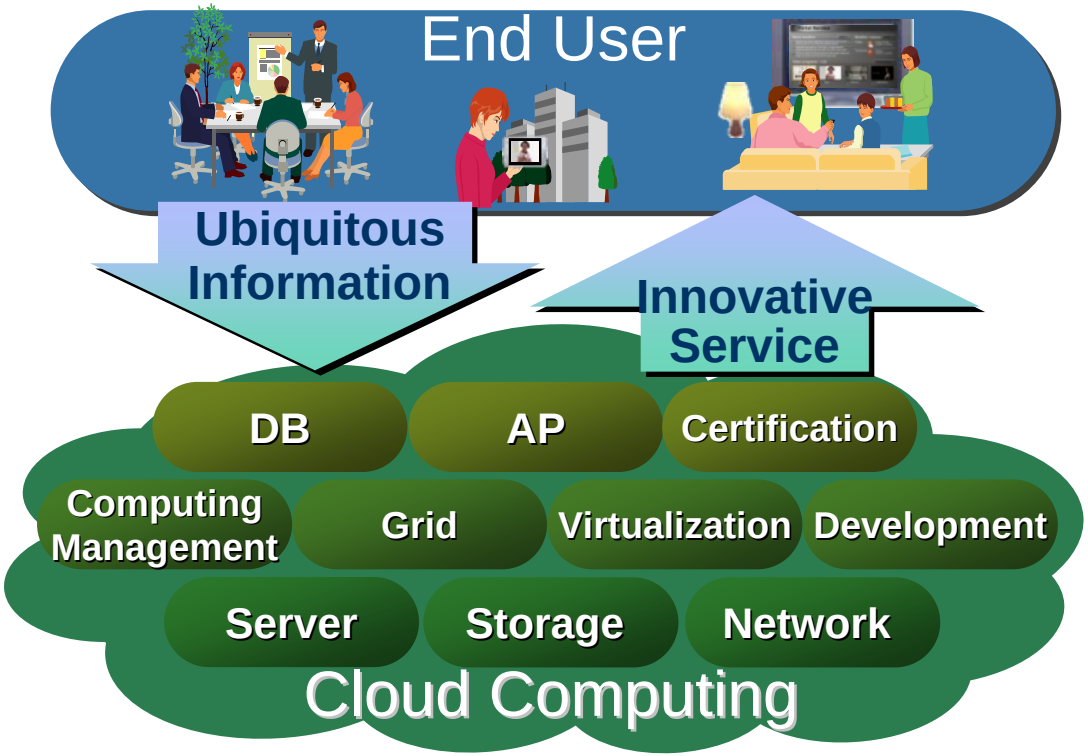
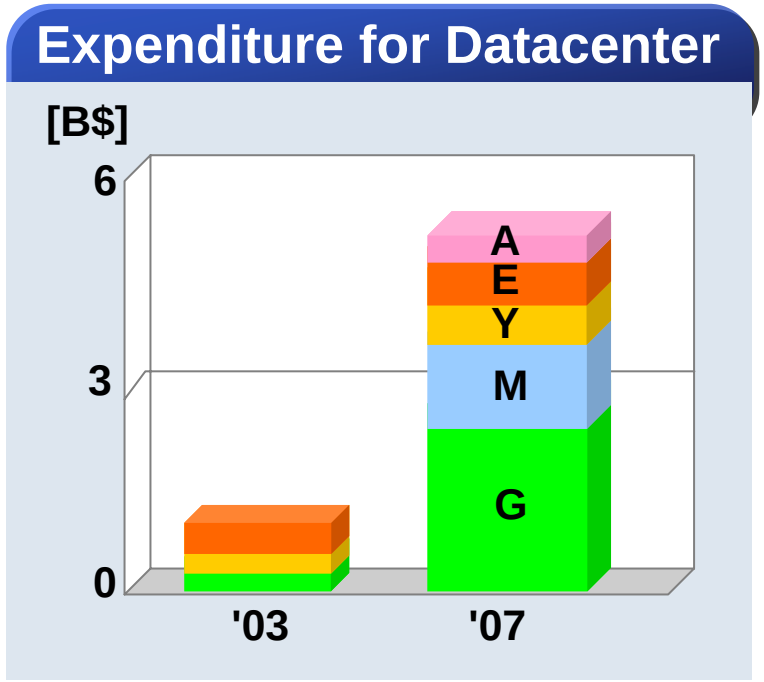
Cloud absorbing huge amount of ubiquitous data will gain ability to generate even more evolutional services. The cycle will go on.




**Cloud computing enables service providers to acquire valuable information and store them in the black box**

# 1-5. Social Infrastructures on Cloud

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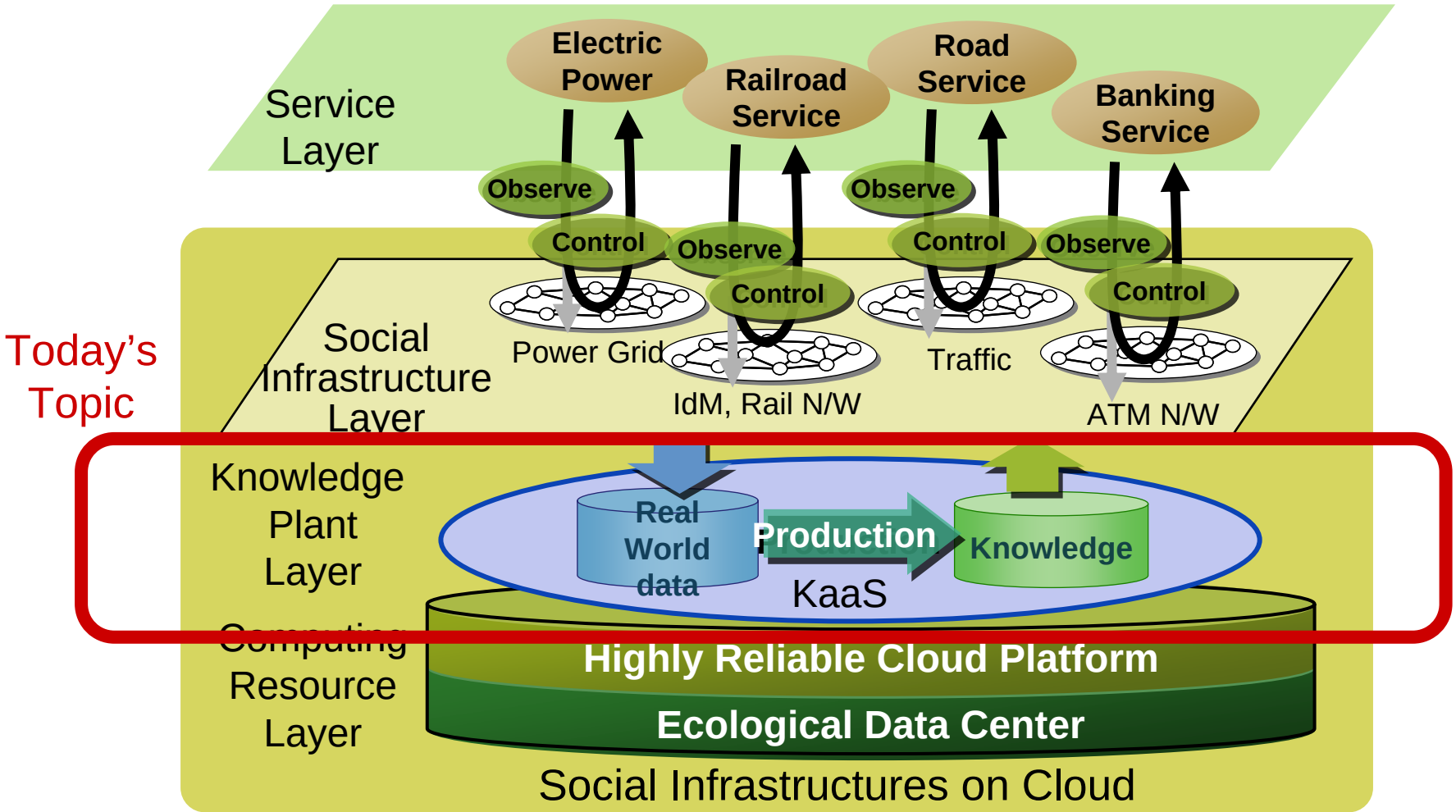


**Social Infrastructures on cloud computers enable to observe, optimize and control real world**



KaaS (Knowledge as a Service) is the trademark of Hitachi, Ltd.

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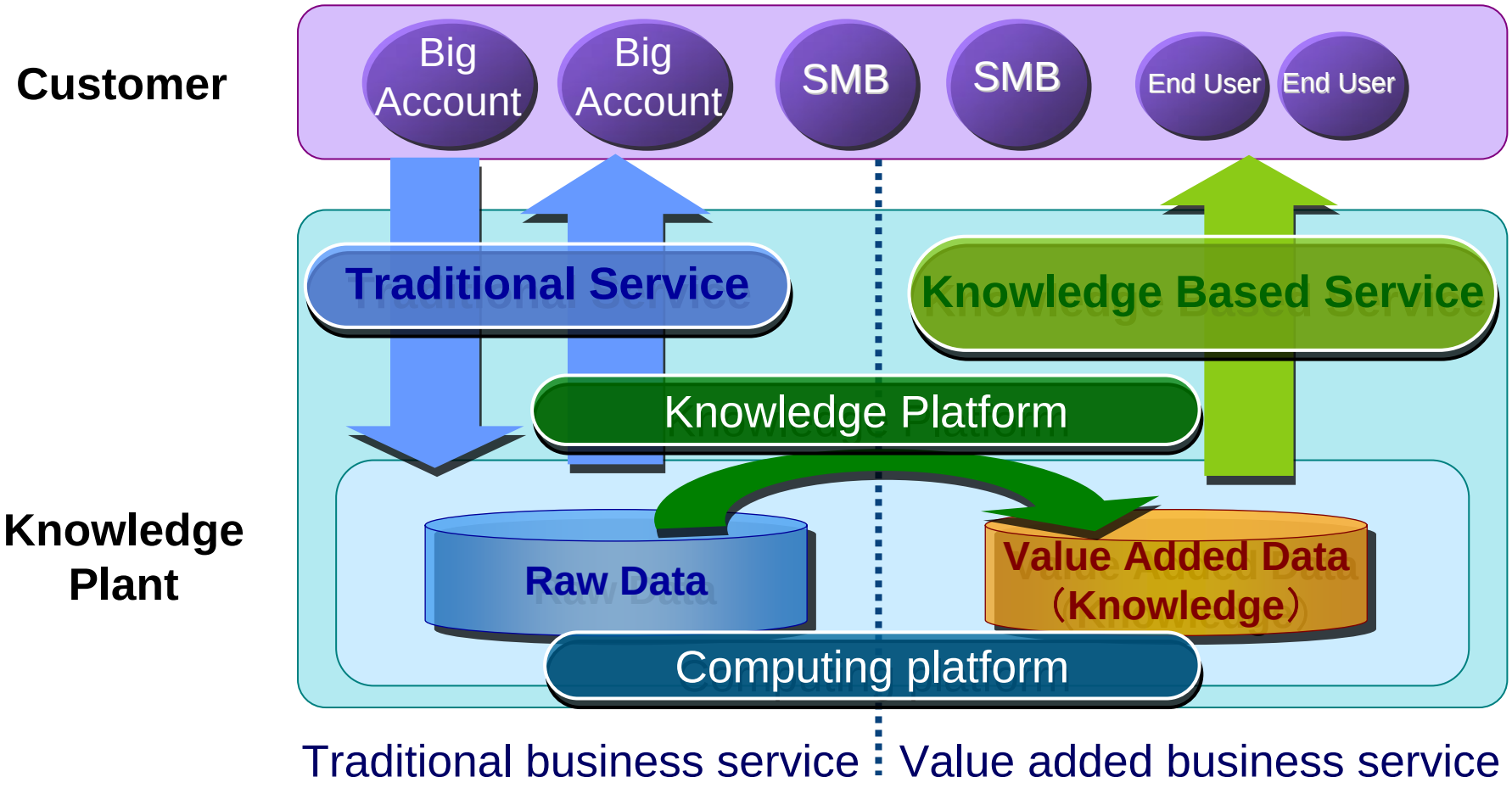


"KaaS(Knowledge as a Service)business model" is one of the keys for IT service business to grow

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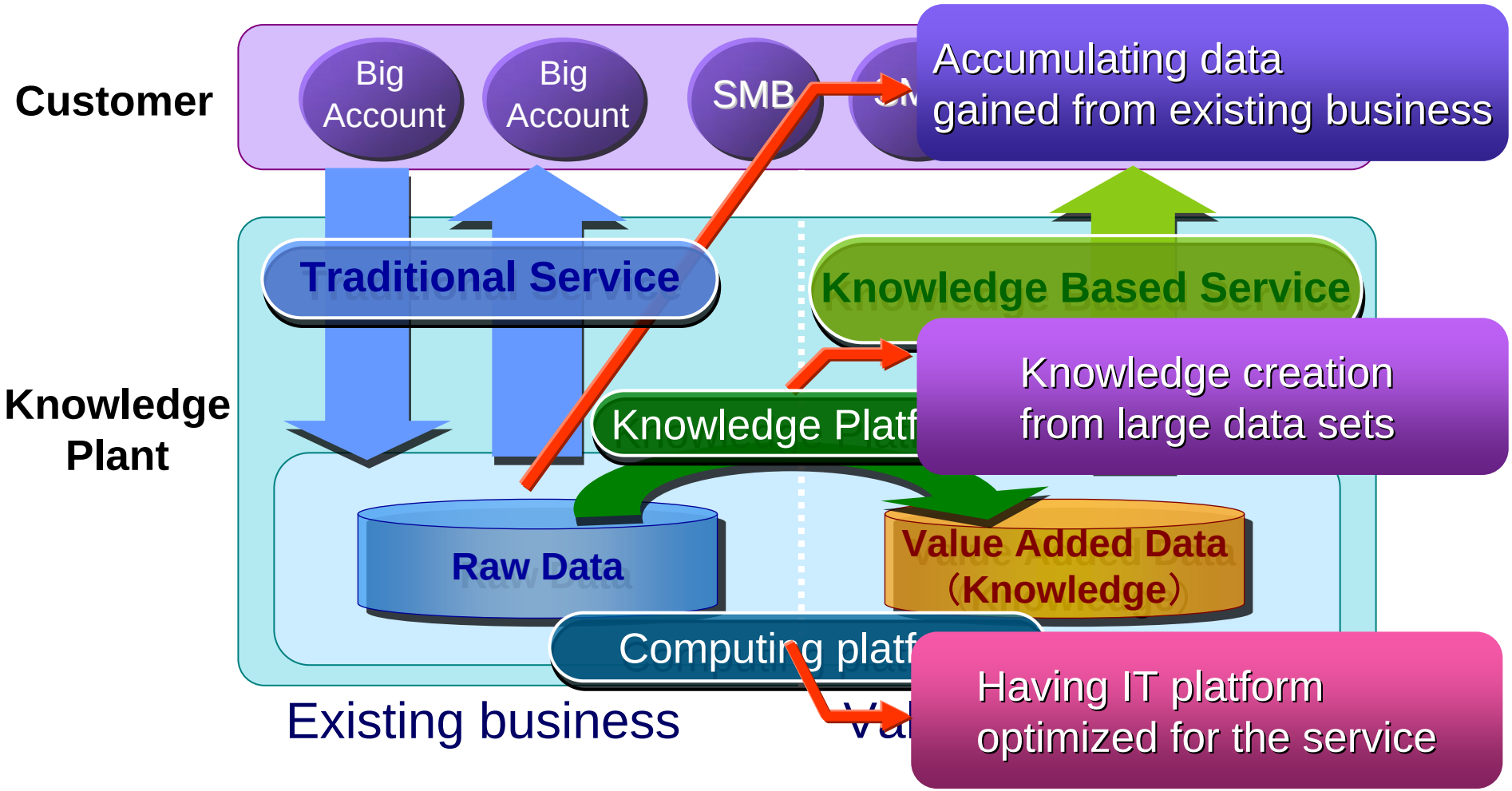
# KaaS business model characteristics



# 2-3. What to Do

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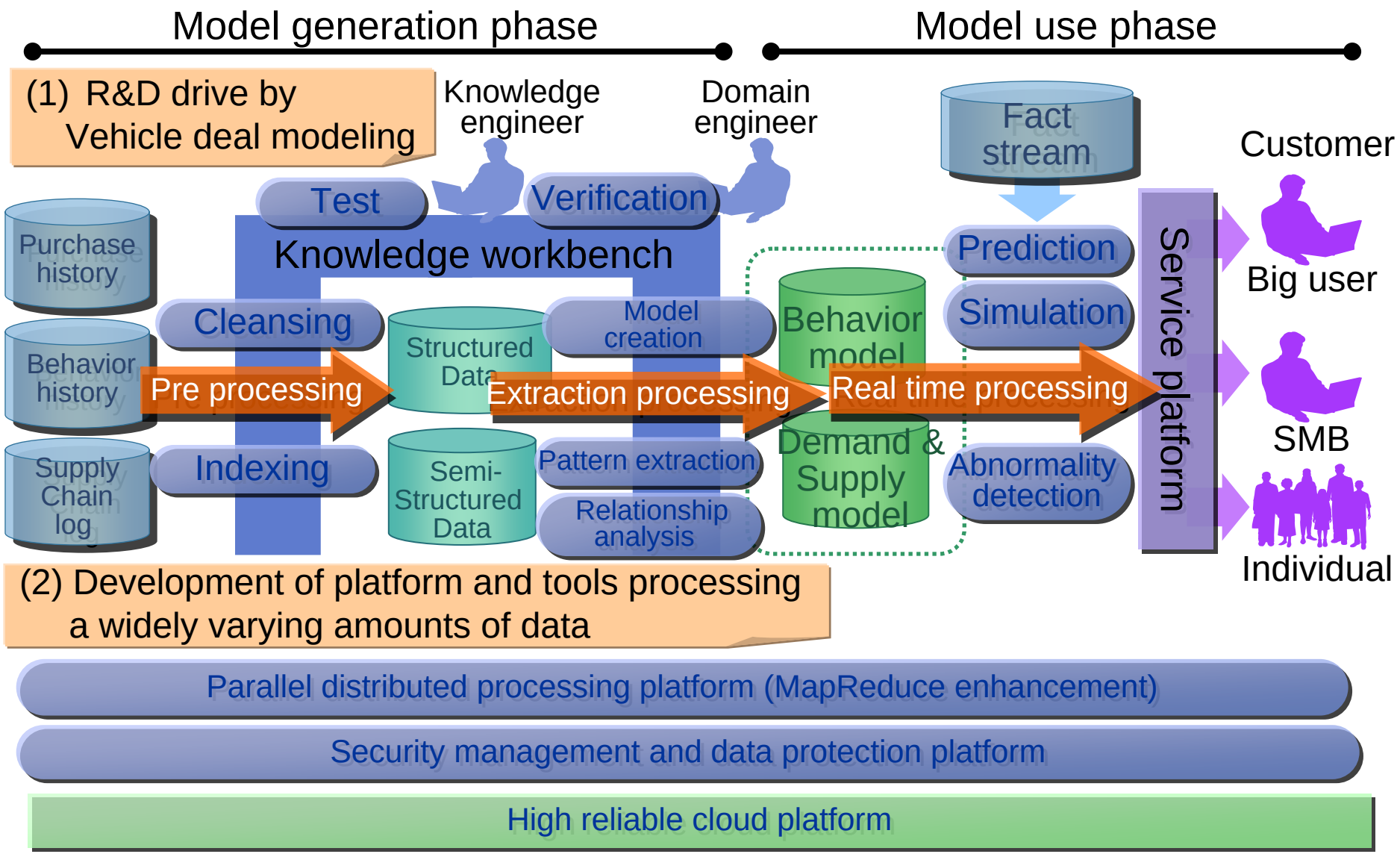
## Knowledge Platform

- Data processing/structuring technology based on the real business data characteristics
- Continuous business/future trend prediction methodology and simulation technology
- Provide a service business platform by enabling new technological components to be plugged in

## Computing Platform

- Essentially new datacenter architecture for the real business data to be processed in a highly effective manner
- Adoption of emerging electronics technologies to enable ultra-low electricity consumption per operation
- A datacenter to be regarded and controlled as if it were a single computer

# 2-4. KaaS Overview and Research Approach



# 3-1. Risk Management Strategy for Cloud Security

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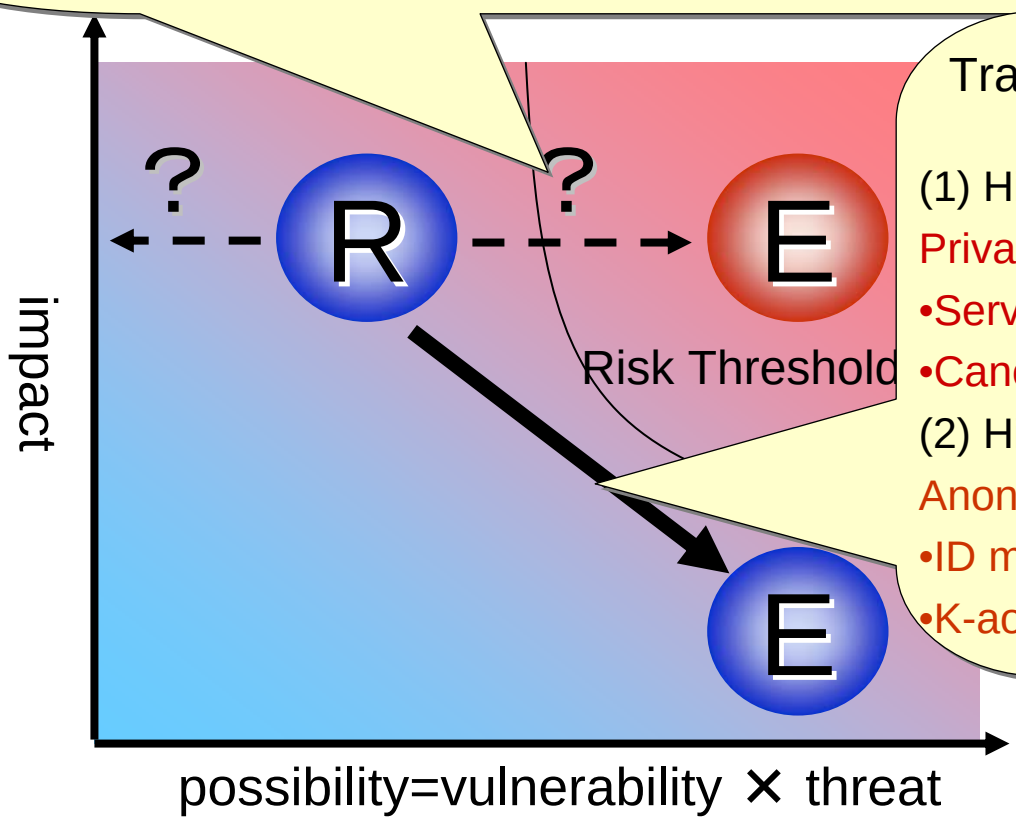
## Clarify and keep service level agreement of security

- Guidelines for ASP/SaaS information security measures of MIC(*1)
- SLA Guideline for SaaS of METI (*2)
- Information Security Management System(*3)




## Transform outsourced data to secure by Technology

(1) Hide all of secret information

Private Information Processing

- Server-aided Computation
- Cancerable Biometrics

(2) Hide only identifiable information to person

Anonymization

- ID management and field isolation
- K-aonymization

Risk＝impact×possibility

R: Risk of in-house data

E: Risk of out-sourced data

(*1) Ministry of Internal Affairs and Communications
(*2) Ministry of Economy, Trade and Industry
(*3) ISO/IEC 27001

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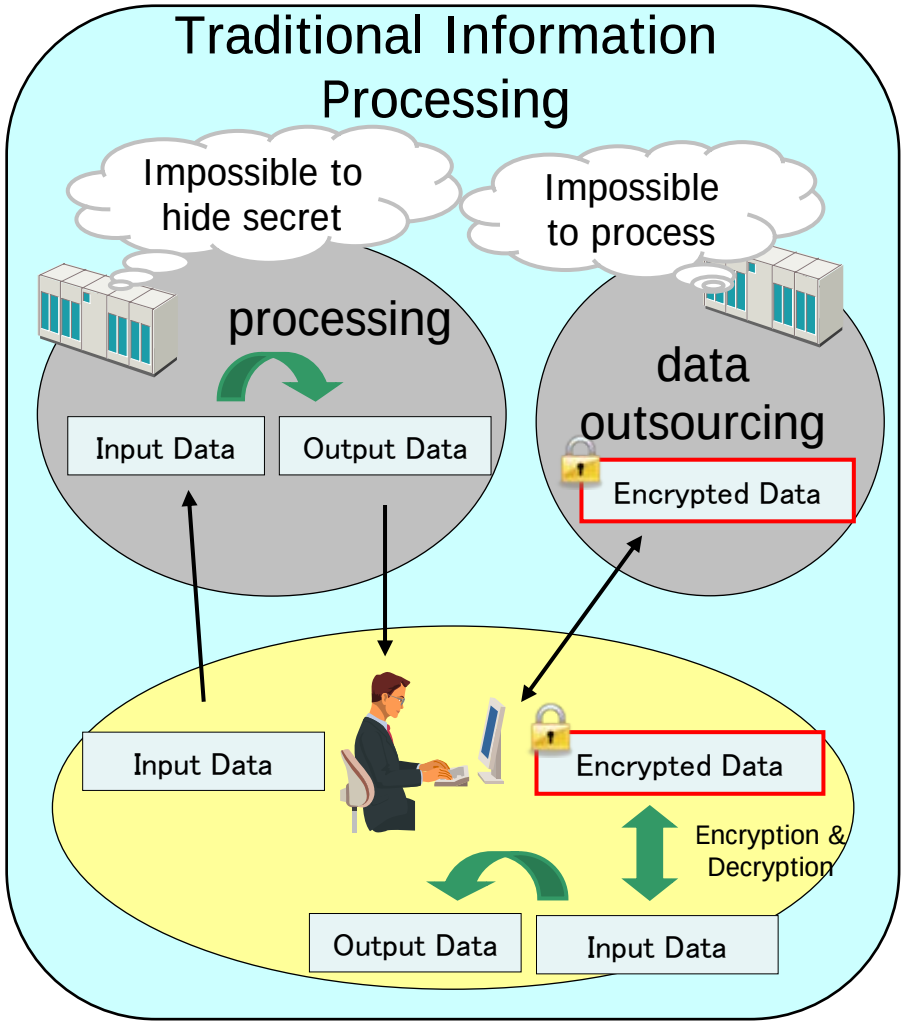
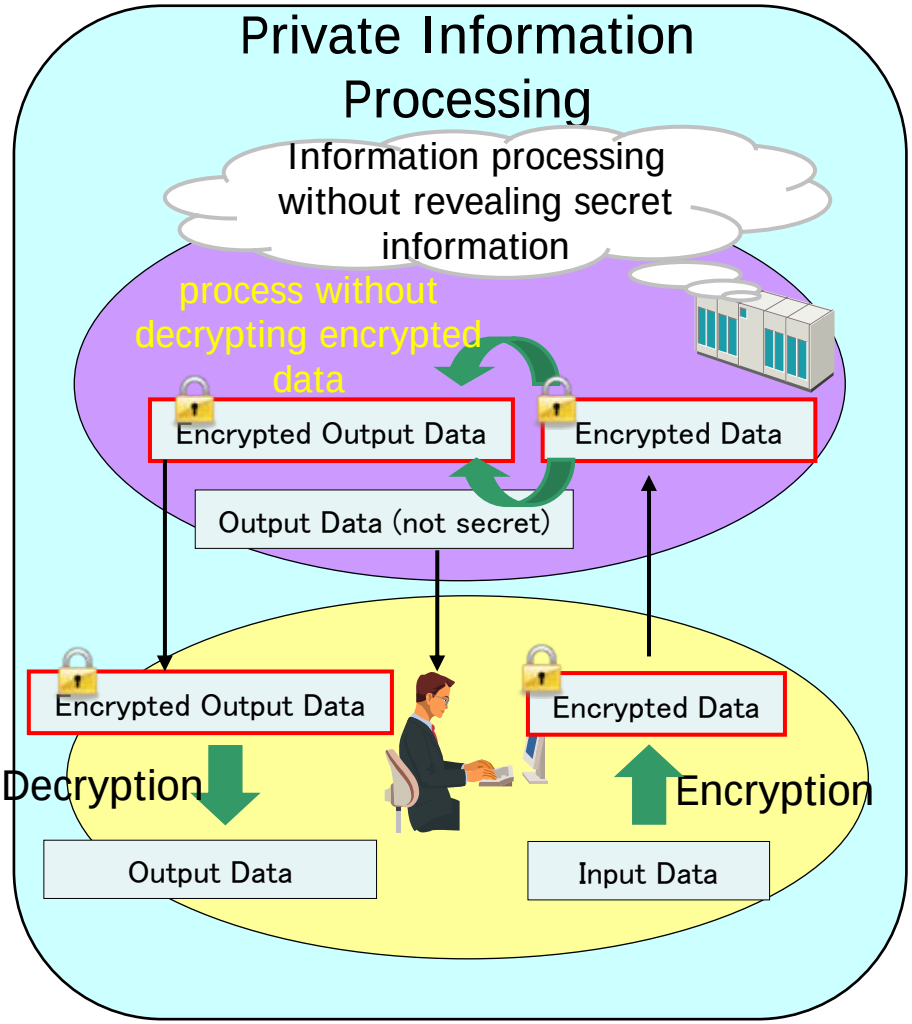
**Private Information processing (PIP) is a computing paradigm, which can process without decrypting encrypted data**

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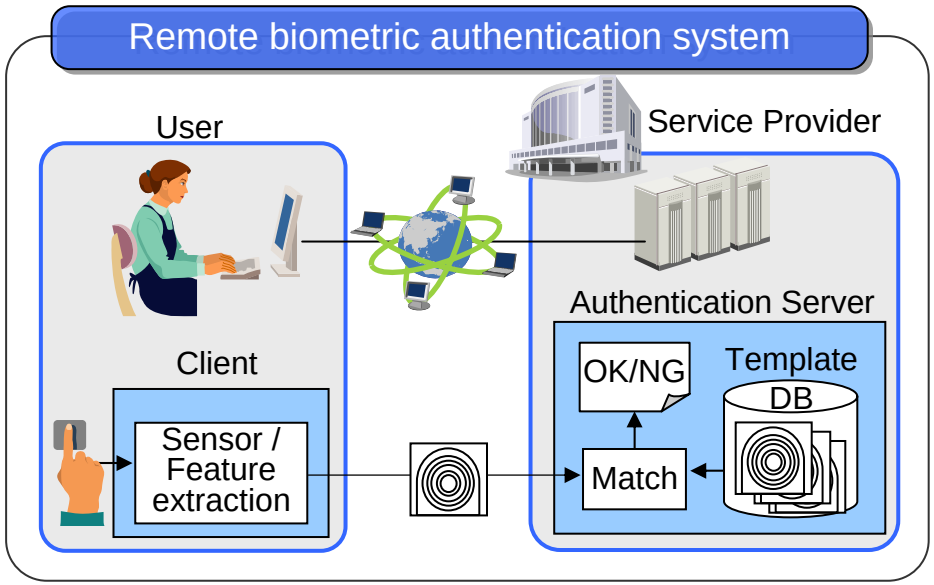
## Expectation for remote biometrics

- Expansion of the network society
- Needs for rigorous and convenient user authentication over networks
- Maturity of biometric technologies (e.g. fingerprint, vein, iris, face, etc...)

## Issues of remote biometrics

- Biometric features are
  - Unchangeable / Irrevocable
  - Personal / sensitive information
- Centralized control of templates
  - Risk of mass leakage
  - Internal fraud
- Privacy issues
  - User's anxiety about giving his/her biometric information to the remote server




**Necessity of strict protection of biometric templates**

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## Cancelable biometrics

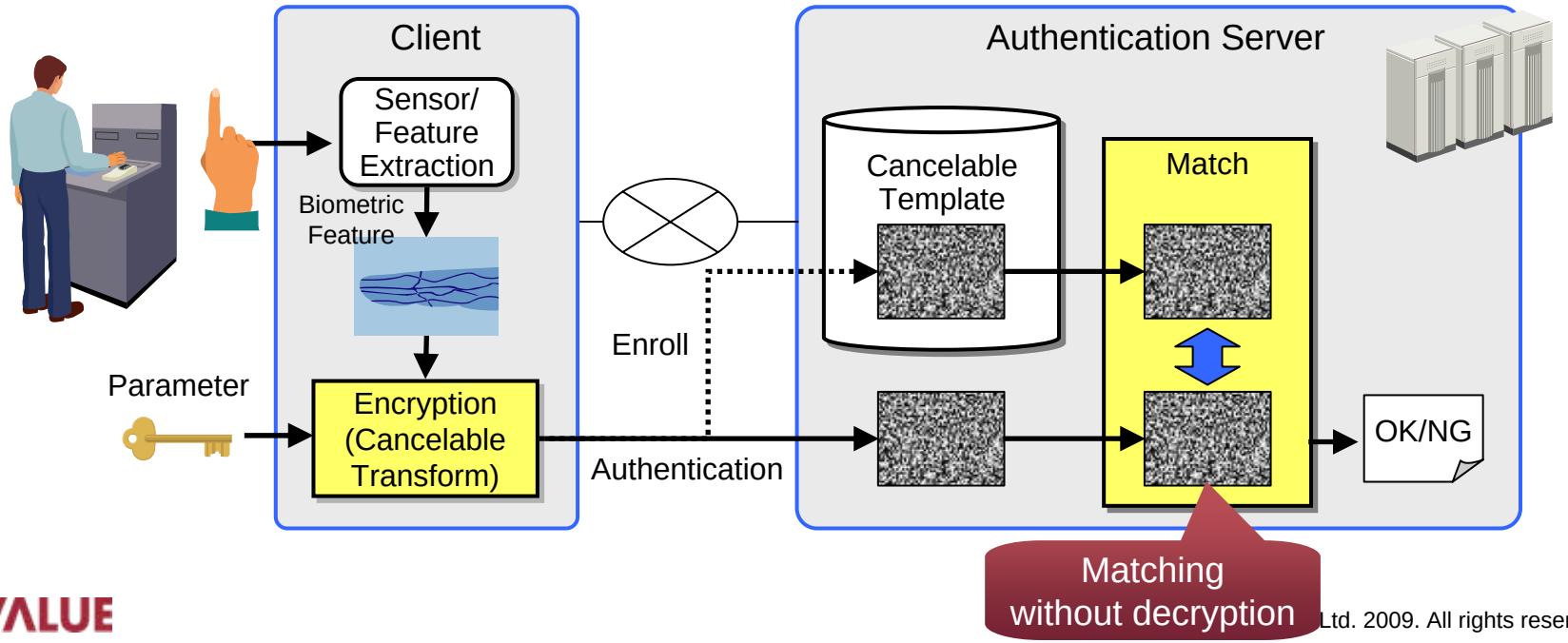
- The biometric authentication scheme with template protection
  - in which biometric features are encrypted, and matched without decryption

## Features

(1) Privacy protection:
- The server can perform the authentication process without knowing the biometric features

(2) High security:
- It is impossible to reuse leaked templates for impersonation.

(3) Cancelable:
- Even if the biometric templates are leaked, they can be canceled by re-encryption.



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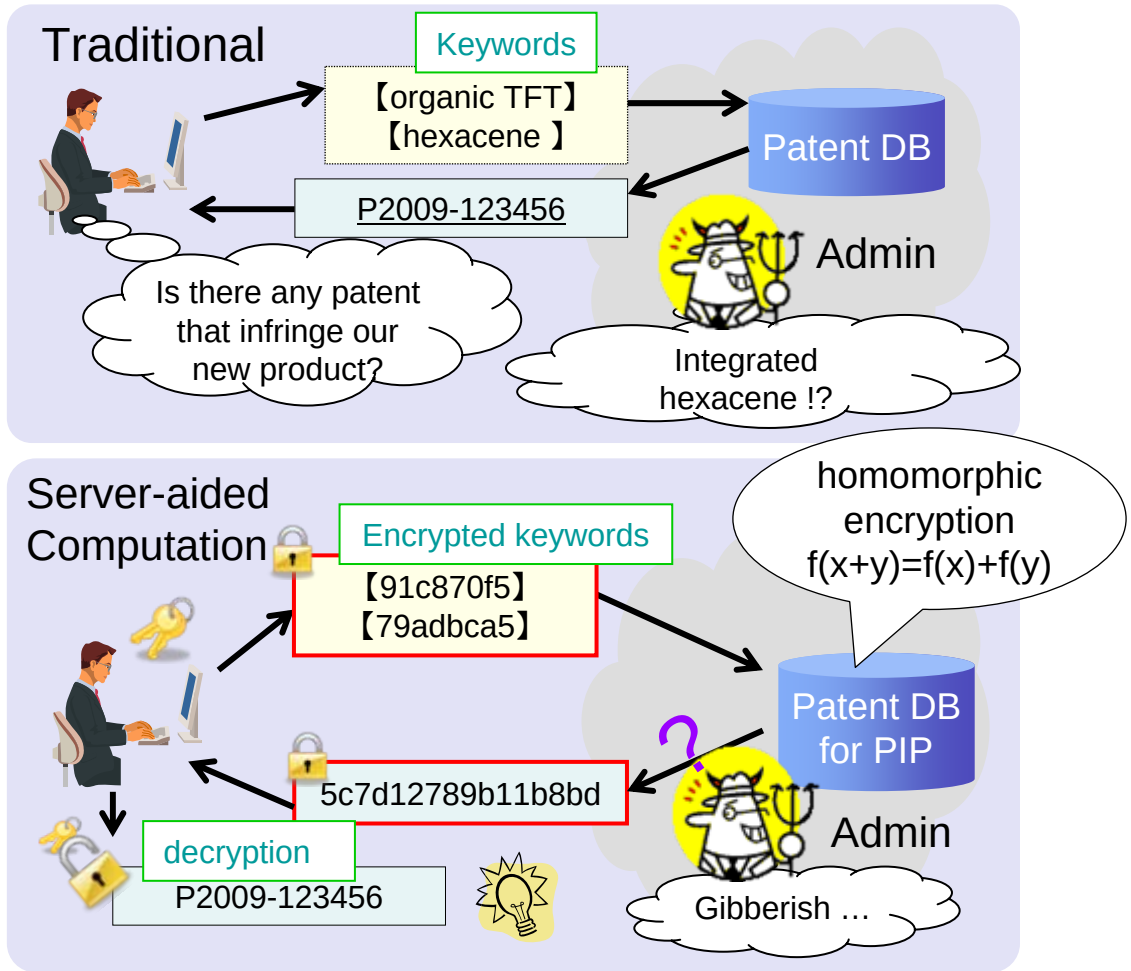
# A PIP model using "*homomorphic encryption*"

**【Example: patent search】**

Disclose keywords closely related to secret to service provider

Search database of clear text with encrypted keywords. Server administrator can not know any information from search process.

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# 3-5. Anonymization for Personal Data

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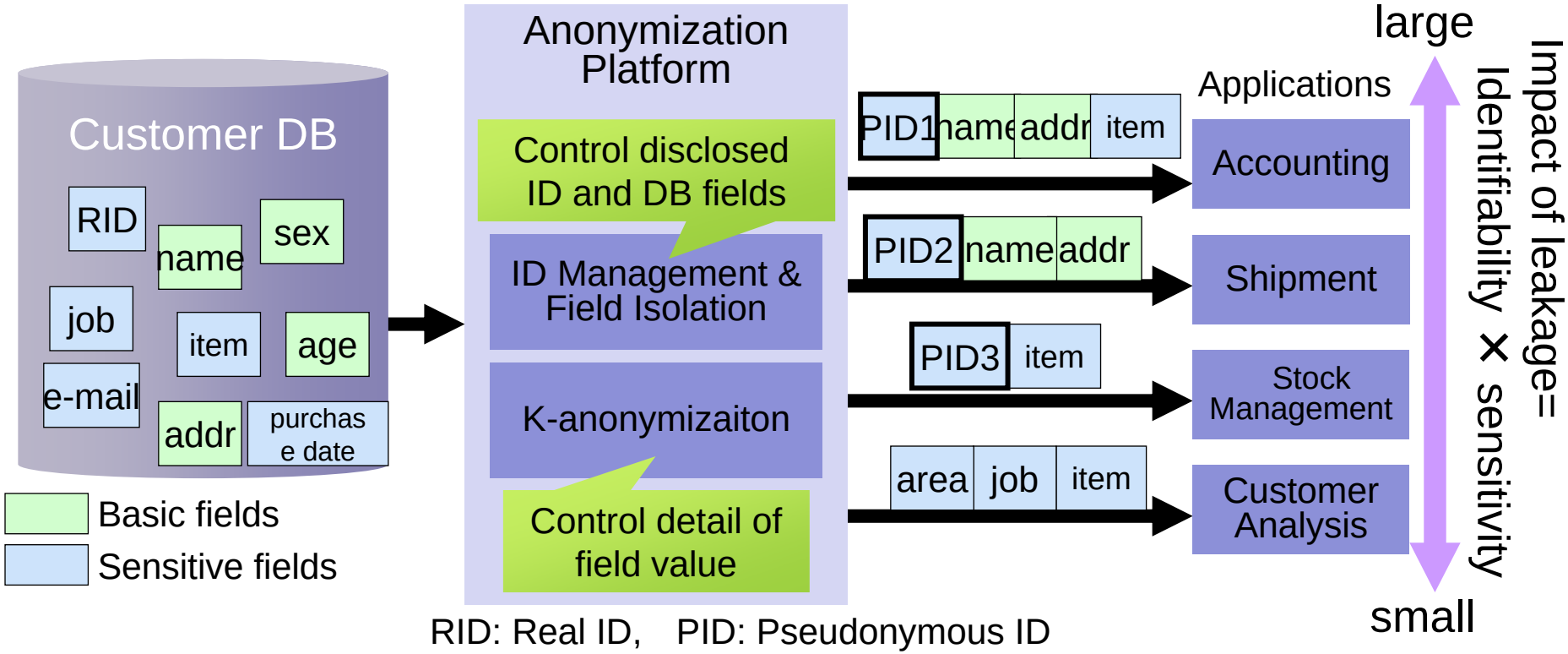
**Control personal ID, DB field, detail of field value according to identification risk of personal data and property of applications**




**Hiding ONLY leakage between person and information enable go together safety and usability of personal data**

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## Exclude identification risk in personal data with minimum information loss

| ADDR | AGE | SEX | HOME TOWN | MARRIAGE |
|---|---|---|---|---|
| Tokyo | 30 | M | Akita | Yes |
| Chiba | 25 | F | Osaka | No |
| Saitama | 30 | M | Tokyo | No |

Generalize un-safety field values

Personal Data

Anonymization

Outsourcing of customer analysis

Identification Risk Evaluation

- Safety cells
- Un-safety cells

| ADDR | AGE | SEX | HOME TOWN | MARRIAGE |
|---|---|---|---|---|
| Tokyo | 30 | M | Akita | Yes |
| Chiba | 25 | F | Osaka | No |
| Saitama | 30 | M | Tokyo | No |

Safety: Satisfy k-anonymity

Un-Safety: Not satisfy k-anonymity if it is used with safe cells

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# 3-6. Directions of Future Works

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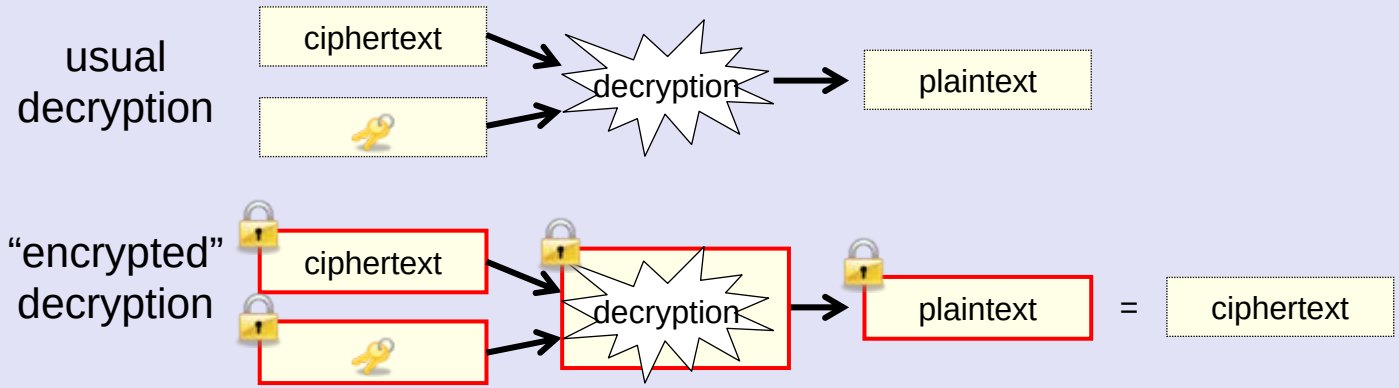
- Research for common technology for any applications
  - Fully homomorphic encryption settles arbitrary transaction
  - Tremendously slow; $10^{12}$+ times
  - Challenge: boost its performance to the practical level

Fully homomorphic encryption is based on “encrypted” decryption




- Research for application specific technology
  - Authentication services: cancellable biometrics
  - Patent search: PIR based on traditional homomorphic encryption
  - Customer analysis: k-anonymization

# 4. Conclusions

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**Social Innovation for Sustainable Society**

Intelligent Information Processing × Real World Data

**KaaS: Knowledge as a Service**