Empowered by Innovation NEC

NEC R&D Aimed at Social Value Innovation

December 3, 2013

Katsumi Emura

Senior Vice President, NEC

Contents

- Environmental awareness
- R&D strategies
- R&D for innovation of social values
- Promoting R&D that contributes to the growth of NEC

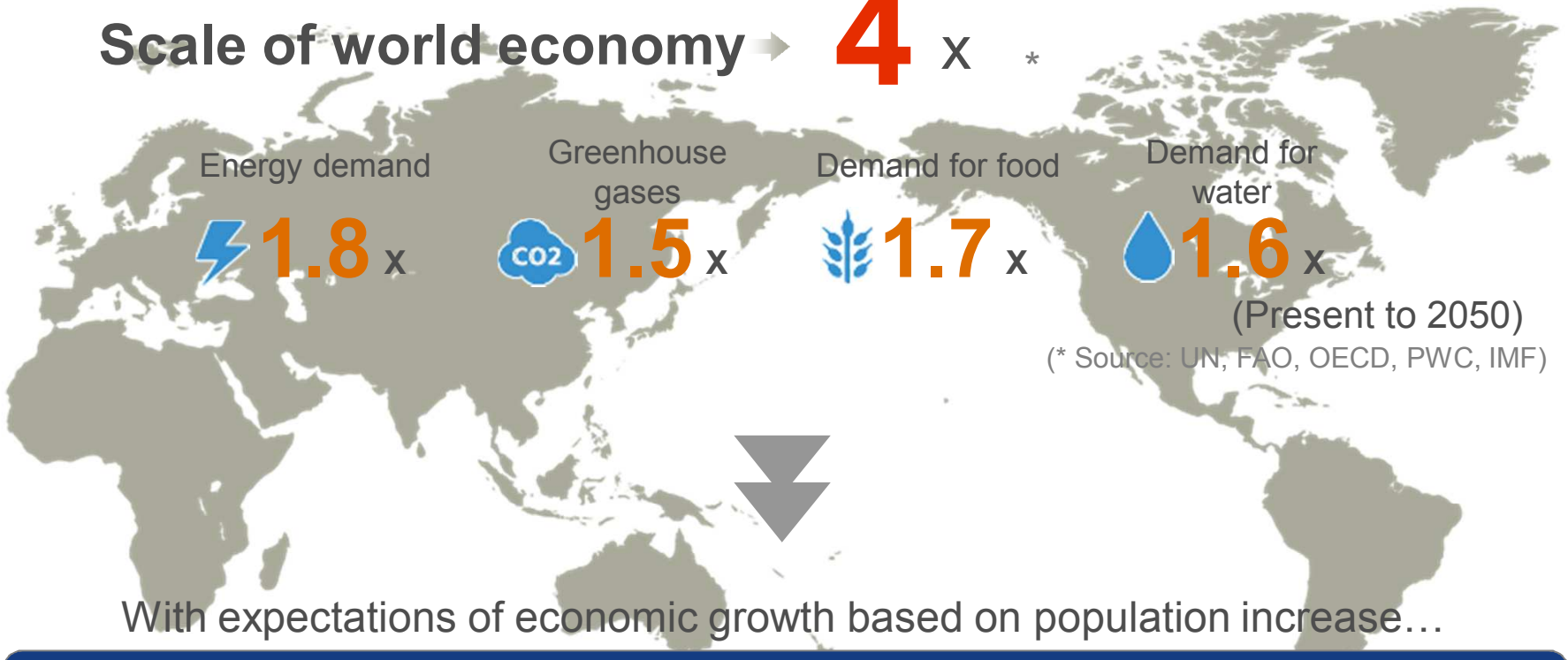
Contents

The Future World Economy

World population: 7 billion → **9** billion (1.3 X)

Ratio of urban residents: 50% → **70** %

Scale of world economy → **4** X *



Energy demand	Greenhouse gases	Demand for food	Demand for water
1.8 x	**1.5** x	**1.7** x	**1.6** x

(Present to 2050)

(* Source: UN, FAO, OECD, PWC, IMF)

With expectations of economic growth based on population increase…

Innovative social infrastructure will be required to make it possible to lead safe and secure lives and make efficient use of resources

NEC's Focus: Solutions for Society

Providing infrastructure for an abundant society for all people via ICT

Social Value Innovations

Safety 安全 | Security 安心 | Efficiency 効率 | Equality 公平

Supporting the Evolution of Worldwide Social Infrastructure through ICT

Energy / Meteorology

Agriculture

Manufacturing

Distribution

Transportation

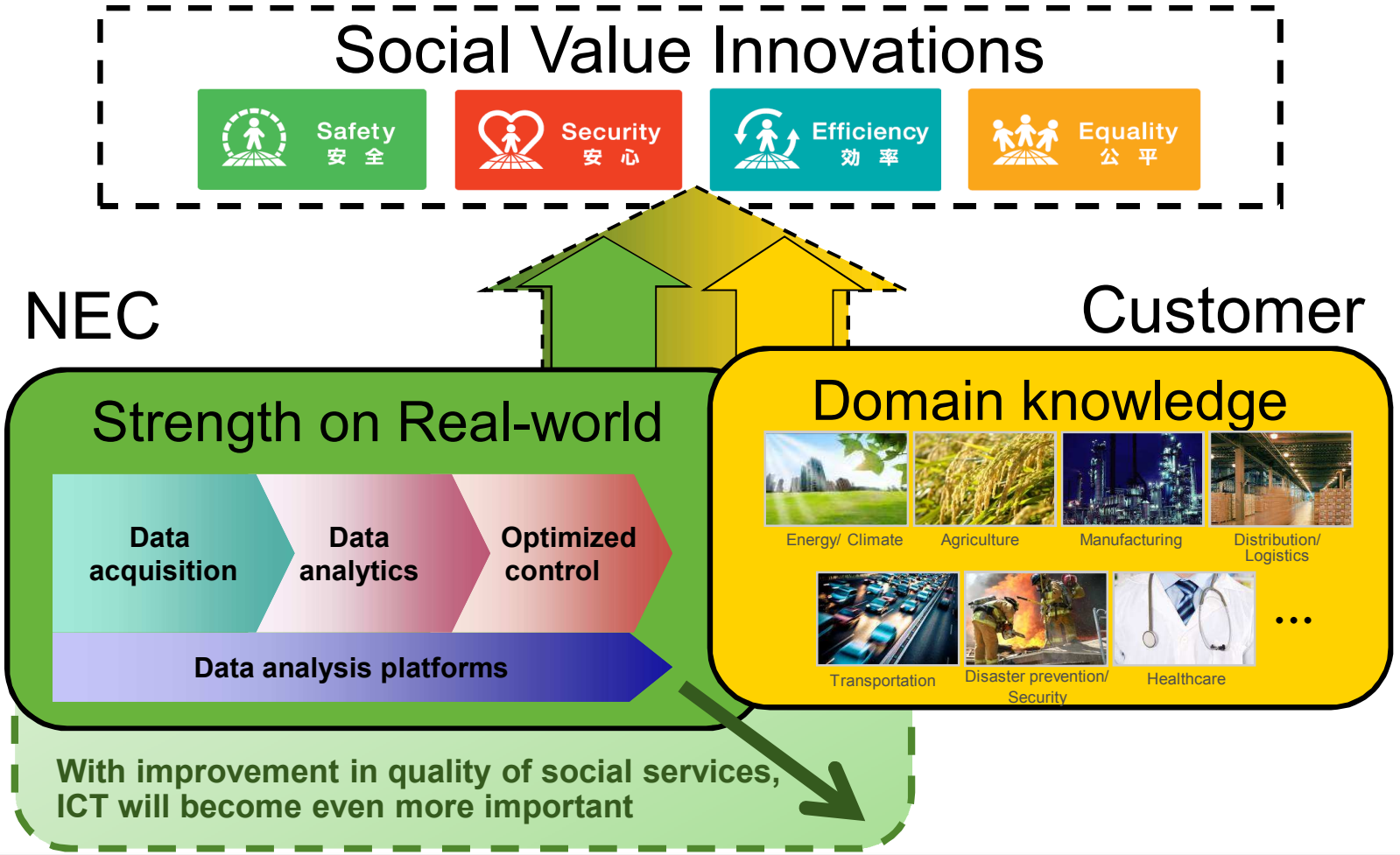
Disaster prevention / Security

Medicine

...

Collaboration with Customers Engaged in Resolving Real World Problems

- **Direct involvement of ICT in customer's efforts to resolve social problems**
- **Leverage NEC's strength on real-world in solving problems**



NEC Technologies that Underpin the Advancement of Social Infrastructure

Increasing opportunities to provide values utilizing NEC's ICT

Social Value Innovation

Safety 安全 | Security 安心 | Efficiency 効率 | Equality 公平

NEC

Customer

Strength on Real-world

Domain knowledge

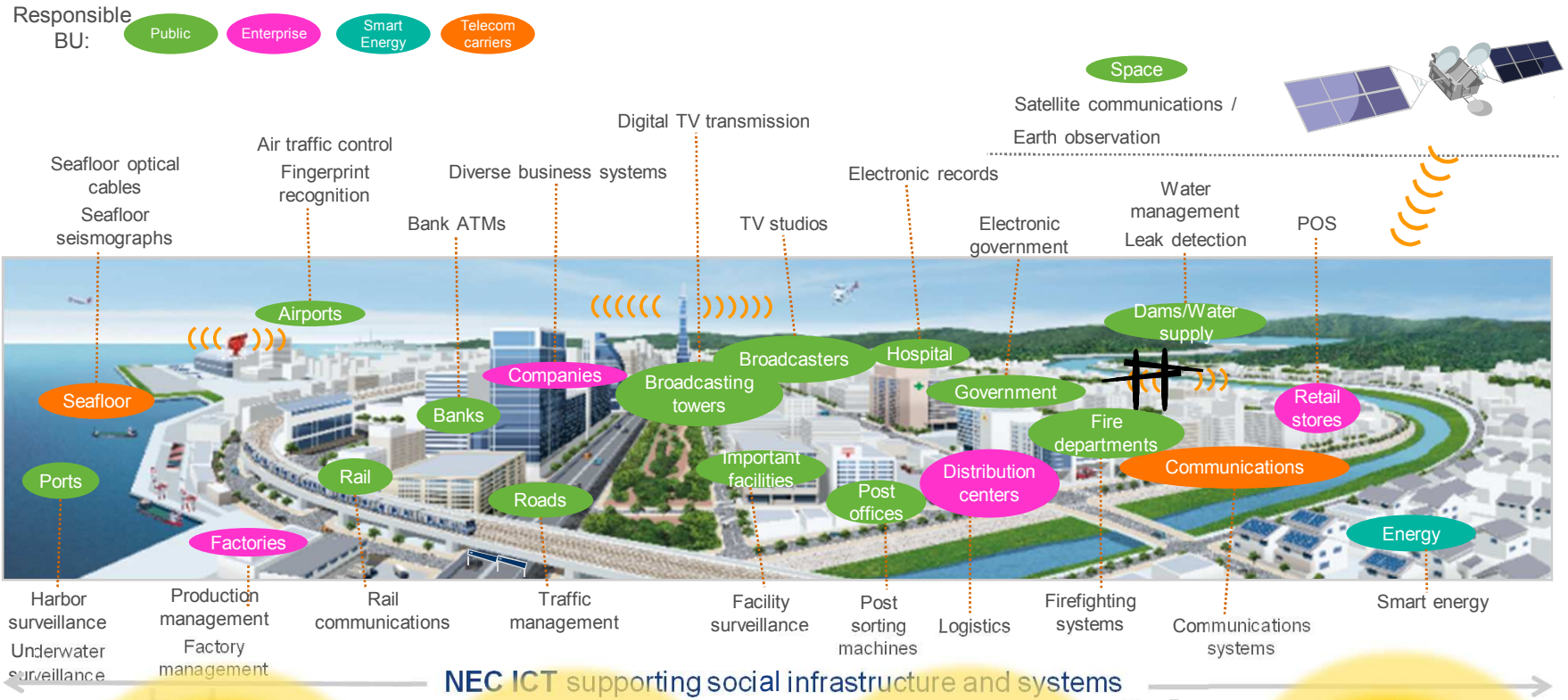
Future development

Acquisition of real-world information		Prediction and forecasting from Big Data	
Optimization of immigration control		Predictive monitoring of social infrastructure failures	
Sensing abnormalities in public spaces		Quality control for vehicles, trains, airplanes, and ships	
Surveillance under dark and poor weather conditions		Predictive monitoring of power plant failures	
Visualization of all lines of movement		Predictive monitoring of manufacturing plant failures	

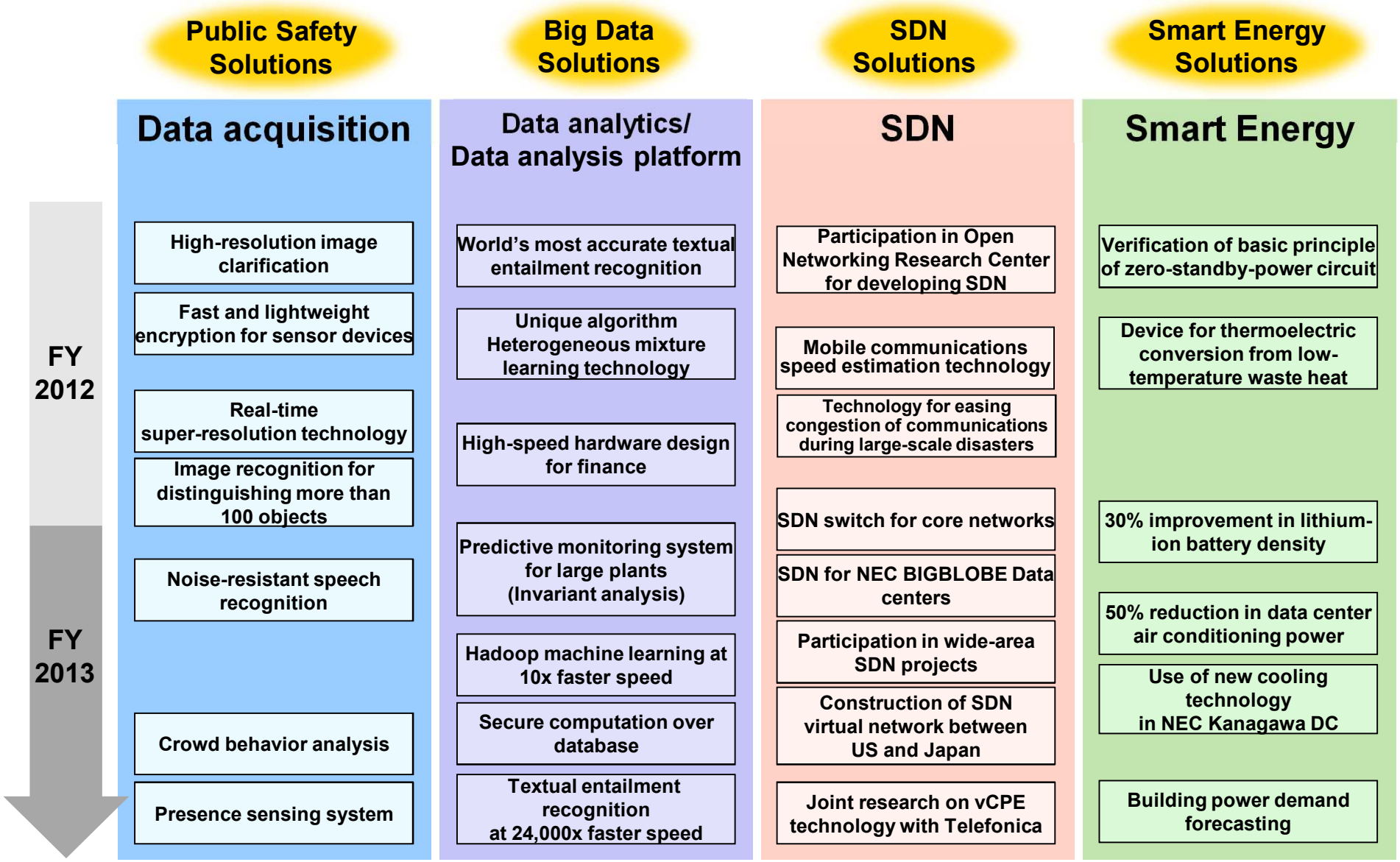
Recognition technologies | Vibration sensing | Invariant analysis | Heterogeneous mixture learning

Innovation of Social Infrastructure via ICT

Concentrating management resources in areas in which social infrastructure will be innovated by ICT

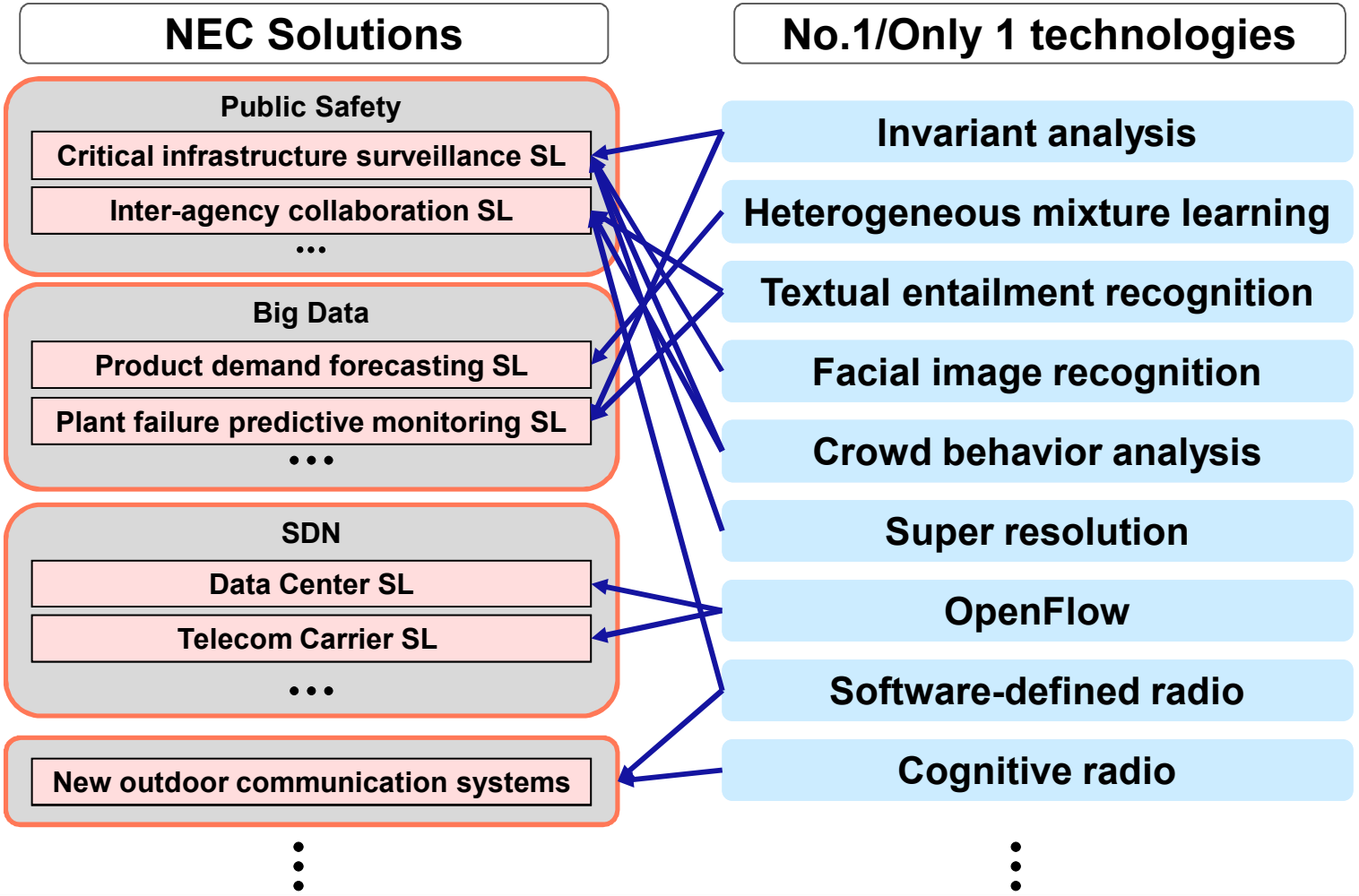


Continuous Creation of No.1/Only 1 Technologies



R&D Underpinning NEC's Solutions

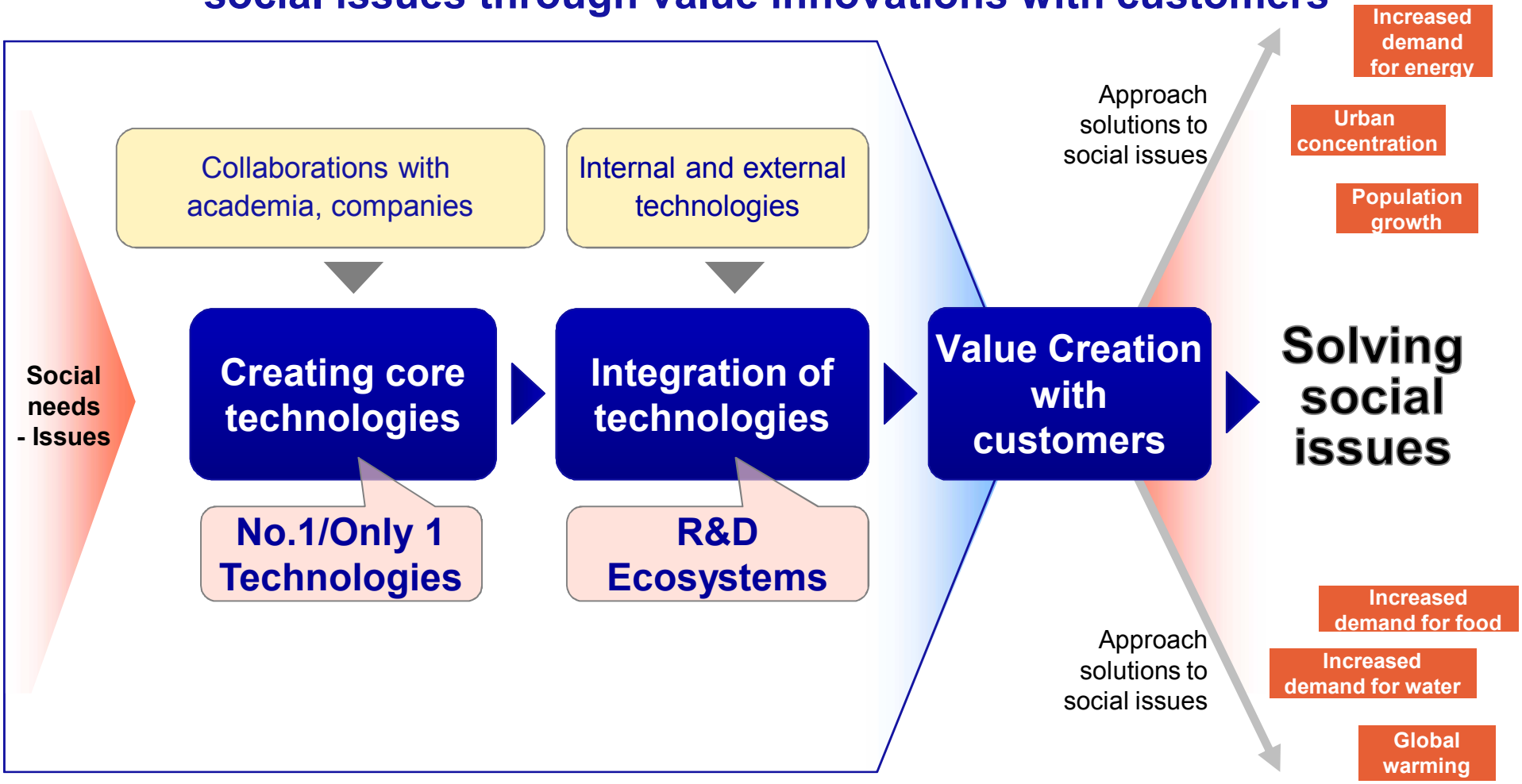
Drive advancement of social infrastructure through creation and combination of No.1/ Only 1 technologies and contribute to current and future business



Contents

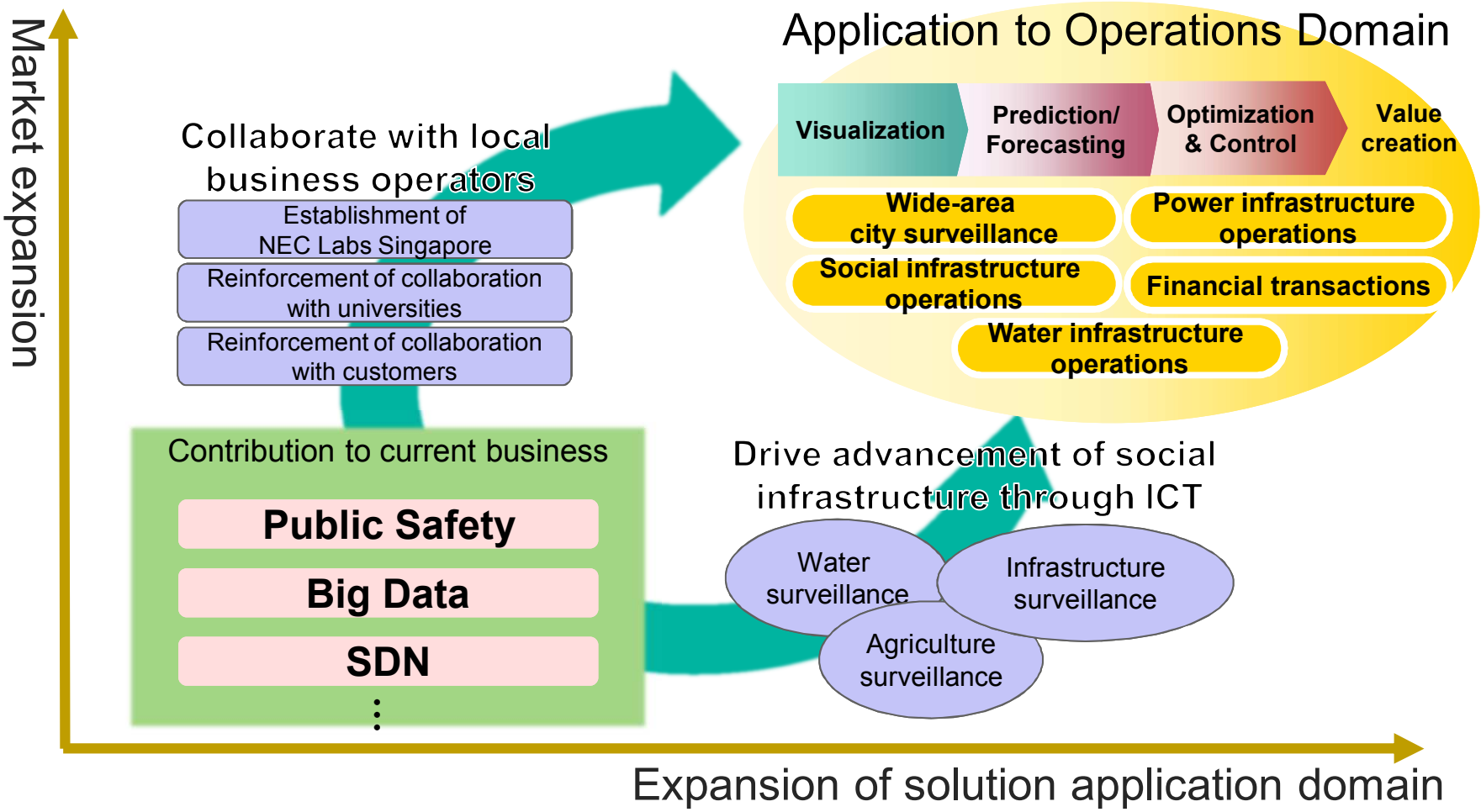
Innovations for Solutions for Society

In addition to creating core technologies and combining essential technologies, we are taking on the challenge of resolving social issues through value innovations with customers



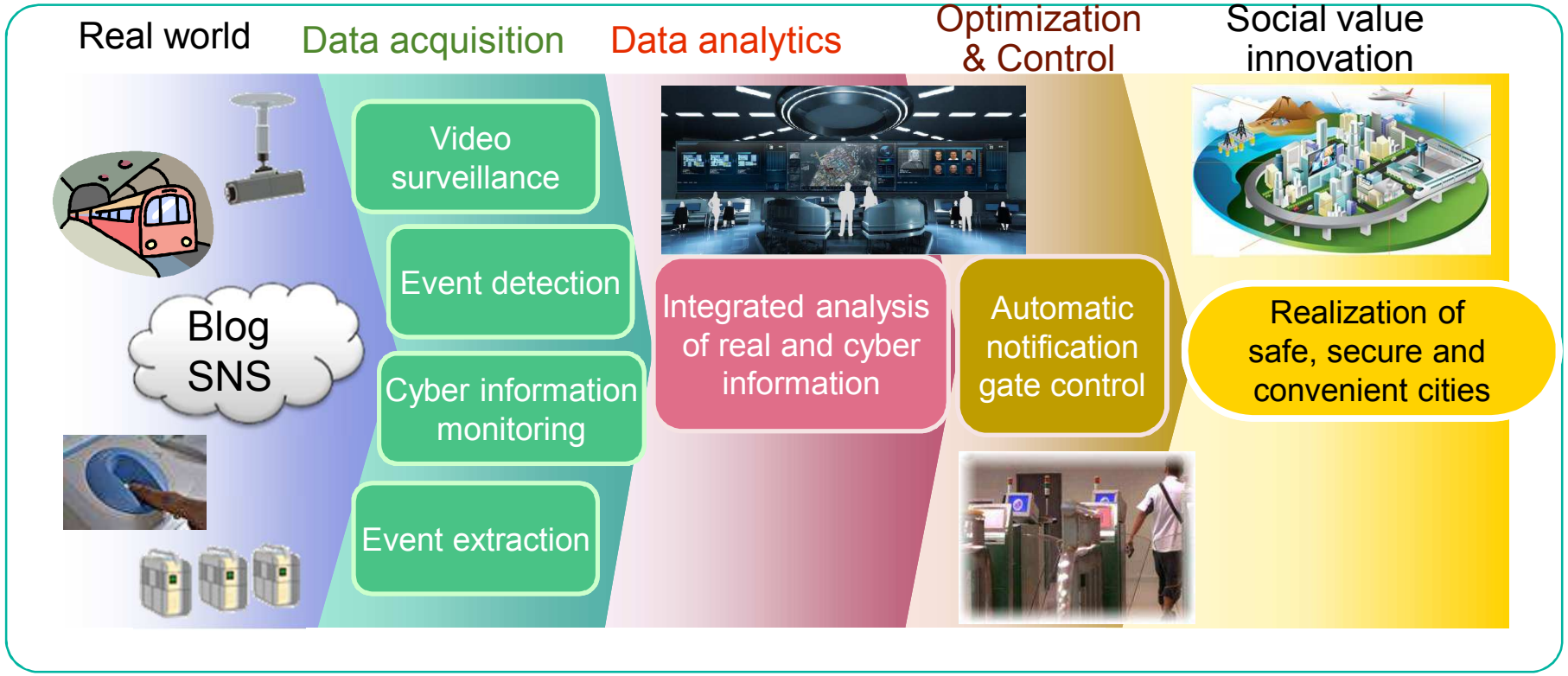
NEC R&D Directions

Expand applicable targets and markets for solutions, apply to operations domain, and leading the transformation of NEC



Initiatives in the Operations Domain: Smart Cities

City operations for building safe, secure, and convenient communities



→ Offer new value to governments and municipalities

Participate as leader of the consortium to carry out “Singapore Safe City Test Bed Projects”.

Contents

NEC Laboratories Mission and Vision

Mission

Continue to create advance technologies that contribute to the realization of an "abundant society," and propel the growth of NEC

Vision

"Value Co-Creation Research Laboratories"

Leverage No.1/ Only 1 technologies in creating value with customers

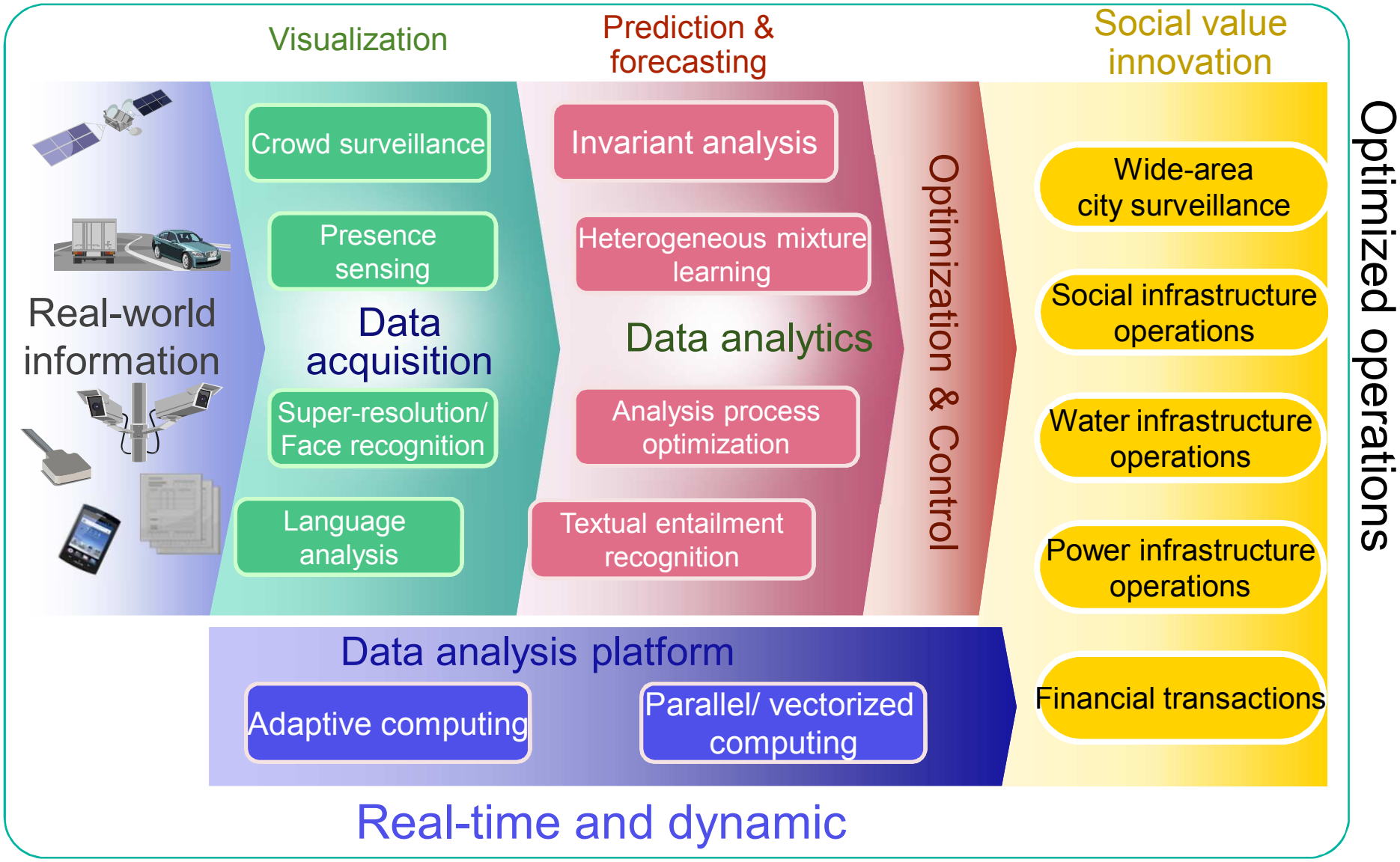
R&D that Contributes to the Growth of NEC

Focus on seven research areas towards advancement of social infrastructure

Energy/ Climate | Agriculture | Manufacturing | Distribution/ Logistics | Transportation | Disaster prevention/ Security | Healthcare | ...

(1)	Big Data: Data acquisition	Expansion of scope for visualization	Optimization & Control
(2)	Big Data: Data analytics	Prediction and forecasting	
(3)	Big Data: Data analysis platform	Real-time	
(4)	Networking	Individualized optimization	Global optimization
(5)	Security	Measures to reduce information leakage risks	Defense from unknown attacks
	Service integration	Customization and downsizing	Facilitation of global deployment
	Energy	Energy use optimization	Shift to convenience for individuals/ society

NEC-developed Technologies that Promote Big Data Utilization



(1) Data Acquisition: Leverage the World's Best Recognition Technologies

Big Data

1960s

Text

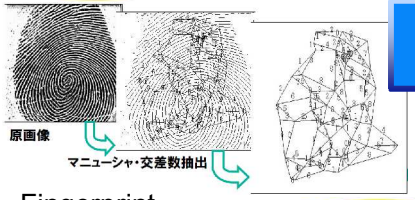
OCR technology
(postal code, documents)

Postal address sorter

Document OCR

Pattern

Fingerprint identification technology **No.1**[*1]



Fingerprint identification

Speech

Speech recognition technology

Natural language processing

Natural language processing technology **No.1**[*2]

[*2]No. 1 in U.S. NIST TAC-RTE

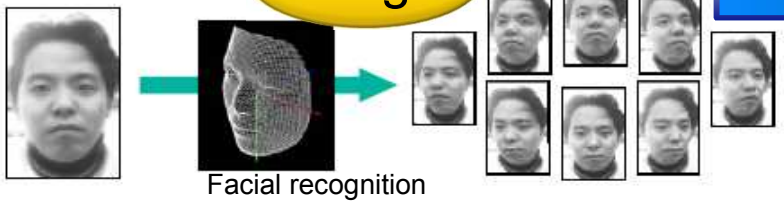
Vibration

Image

Face recognition technology **No.1**[*1]

Video

Video image recognition technology



Facial recognition

[*1]No. 1 in U.S. NIST benchmark tests

Global Best

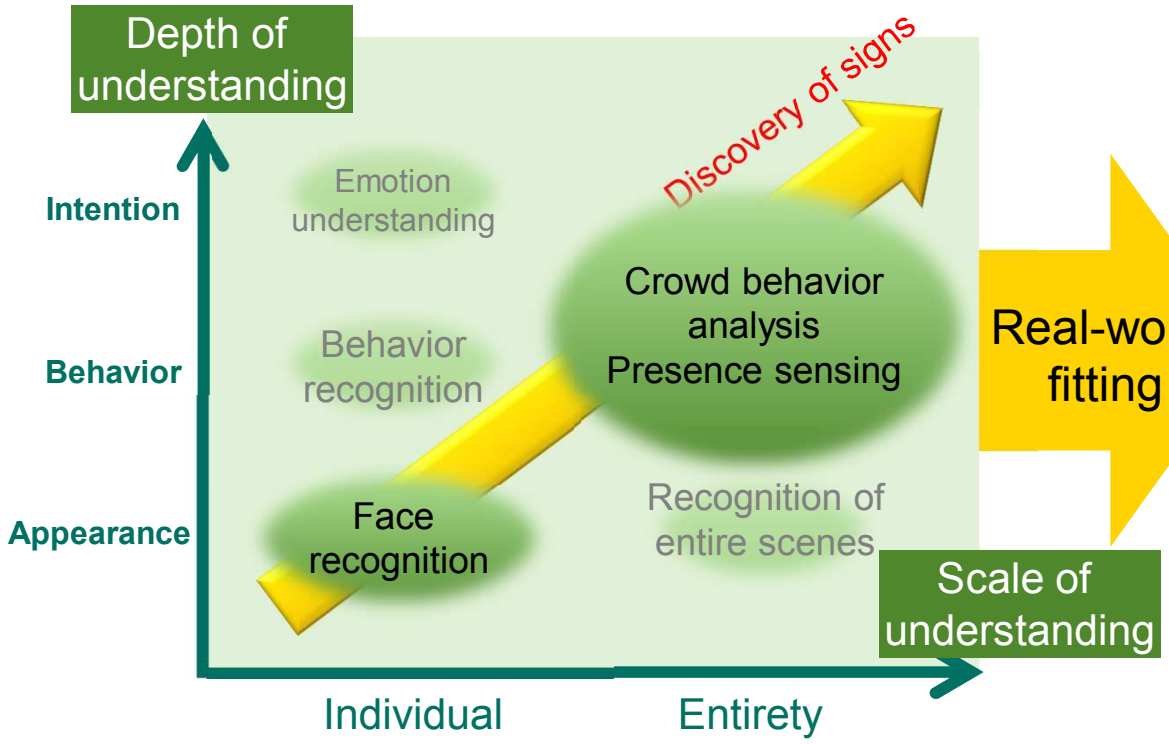
Ownership of the world's best (both qualitatively and quantitatively) recognition technologies built over 50 years of history in research and development of recognition technologies

(1) Data Acquisition: Increase in Quantity and Quality of Data that can be Handled

Big Data

Acquisition and analysis of conventionally difficult to obtain real-world data through the understanding of diverse meanings and the real-world fitting

Visualization of signs of future events



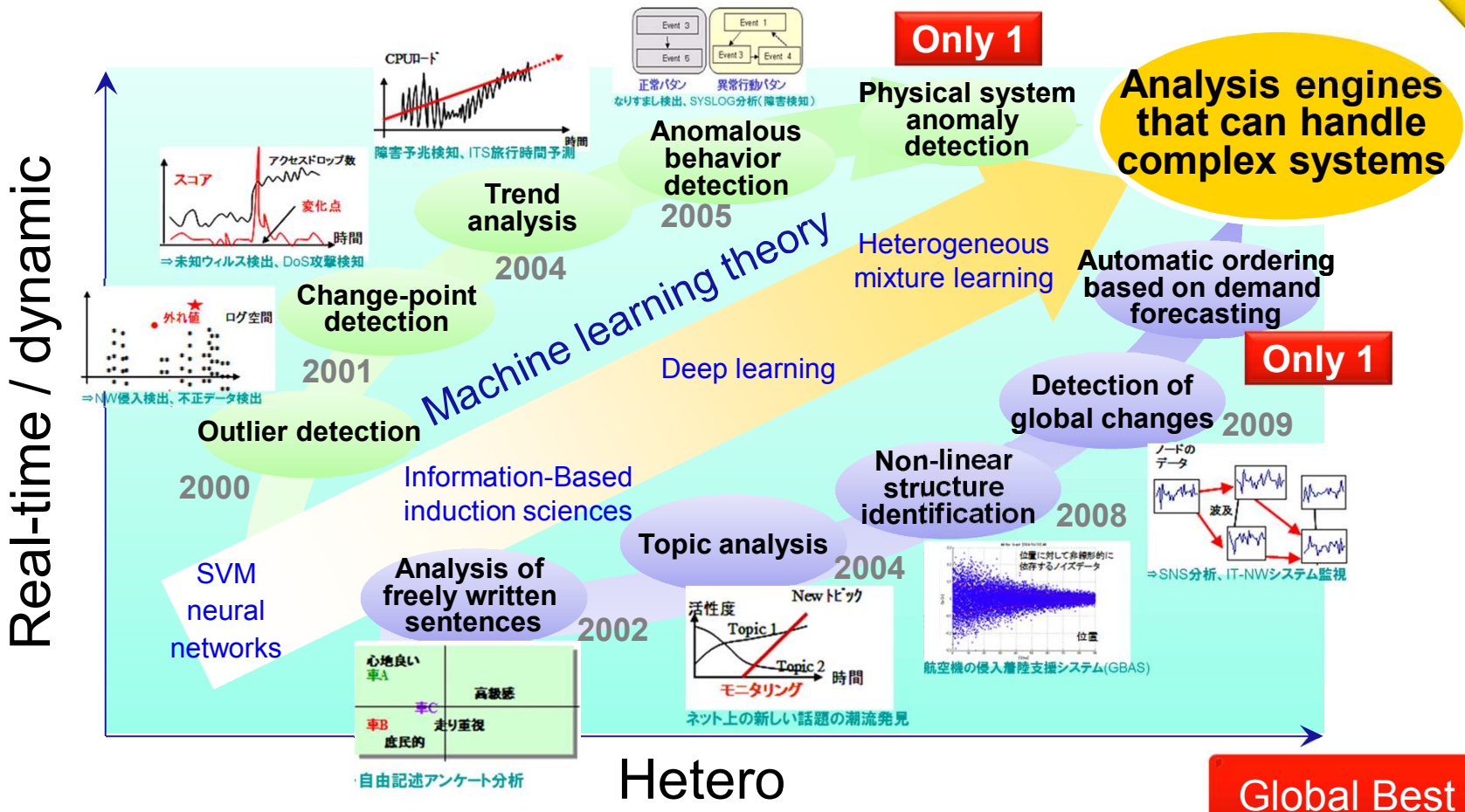
Real-world fitting

New business creation

- City wide-area surveillance and management — Safety 安全
- Efficient social infrastructure maintenance — Security 安心
- Smart store management — Efficiency 効率

(2) Data Analytics: Analysis Engines that can Handle Complex Systems

Big Data



Diverse analysis engines that can handle analysis of complex and large amounts of real-world data and advanced optimization of analysis processes

(2) Data Analytics: Advanced Analysis Engines

Big Data

Realize efficient social infrastructure operations through analysis engines for deciphering big data and optimized control

Global best analysis engines

World's first

Discover "unusual behavior"

Invariant analysis

World's first

Easy derivation of multiple rules

Heterogeneous mixture learning

World's first

Semi-automation of analysis processes

Analysis process optimization

No.1 *

Understanding of entire sentences

Recognizing textual entailment

*No. 1 in NIST TAC-RTE

Optimized control

New business creation

- Smart operation of water infrastructure — Equality 公平
- Smart operation of power infrastructure — Security 安心
- Smart operation of distribution and logistics — Efficiency 効率

(3) Data Analysis Platform: Parallelization & Vectorization Software Technologies

Big Data

Software technologies
(Parallel & vector processing)

Support for 100-node clusters

Automatic distributed memory parallelization for HPF

Parallel distribution MPI-SX

Gordon Bell Prize Performance/ Language Awards

SX-3 Vector Capacity No. 1

Automatic shared memory parallel processing

Automatic vectorizing compiler

Earth Simulator Top500 Rank 1

Parallelization & Vectorization software technologies that maximize hardware performance

Hardware technologies


SX-2


SX-3


SX-4


SX-5


SX-6


ES-2


SX-ACE

1990 **2000** **2010**

Global Best

Realize outstanding performance in Parallelization & Vectorization software technologies through a long history of supercomputer development

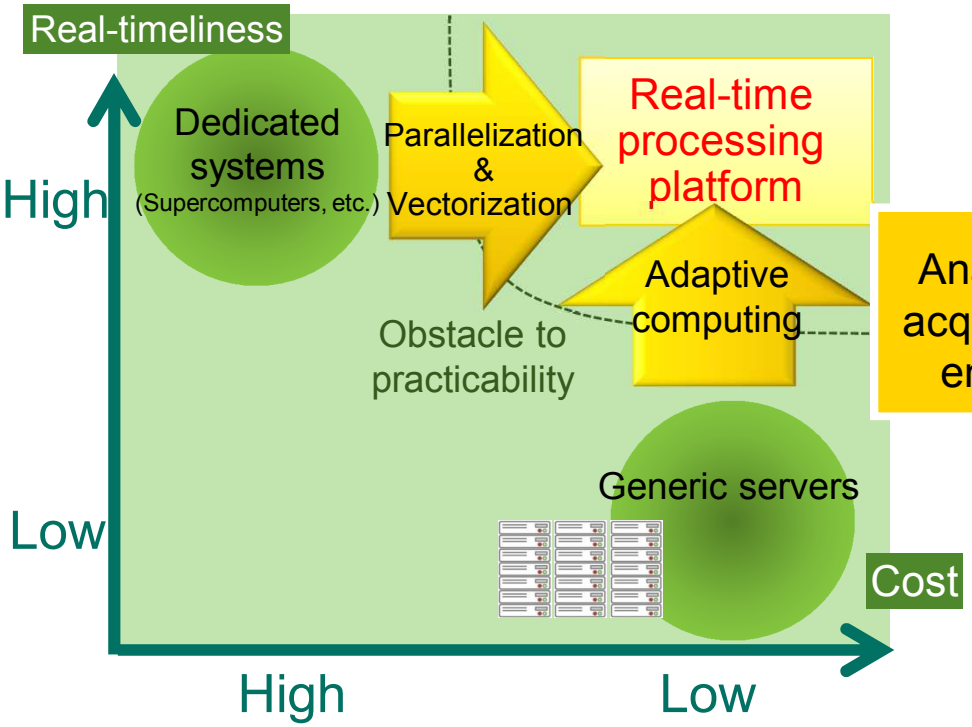
*Gordon Bell Prize: Most authoritative award in high-performance computing

(3) Data Analysis Platform: Pursuing the Highest Level of Real-timeliness

Big Data

Strive for faster speeds and lower costs and realize platforms optimized for real-time operations

Real-time processing platform



New business creation

Analysis/ acquisition engine

- City wide-area surveillance and management — Safety 安全
- Ultra-low latency financial transactions — Efficiency 効率
- Timely endorsement services — Efficiency 効率

(4) Networking: NEC, at the Helm of SDN Advancement

Networking

Stanford University CLEAN SLATE An Interdisciplinary Research Program

R&D on OpenFlow ★World's first OpenFlow-supported products

Open Networking Foundation (Formerly Open Network Consortium)

ONF OPEN NETWORKING FOUNDATION

(Founding member)
Formulation and standardization of OpenFlow specifications

(Founding member)
Leader of SDN R&D

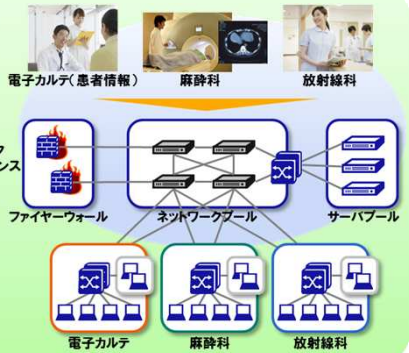
Open Networking Research Center

Open Networking Research Center at Stanford University

Examples of application of SDN products

Kanazawa Univ. Hospital (2012)

Efficient management of medical operations network



80% reduction in labor costs for operations

NEC BIGLOBE

(2013)

SDN-based IaaS

Reduction in network and server construction time from 2 weeks to 10 minutes

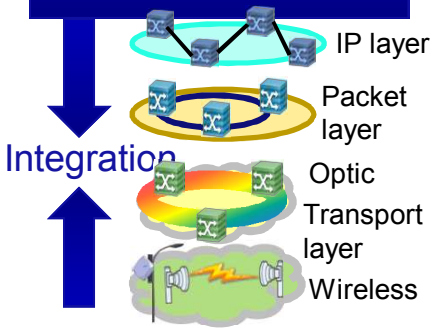
Develop advanced SDN technologies through collaboration with Stanford University, conduct on-site verification of SDN value and accumulate knowhow.

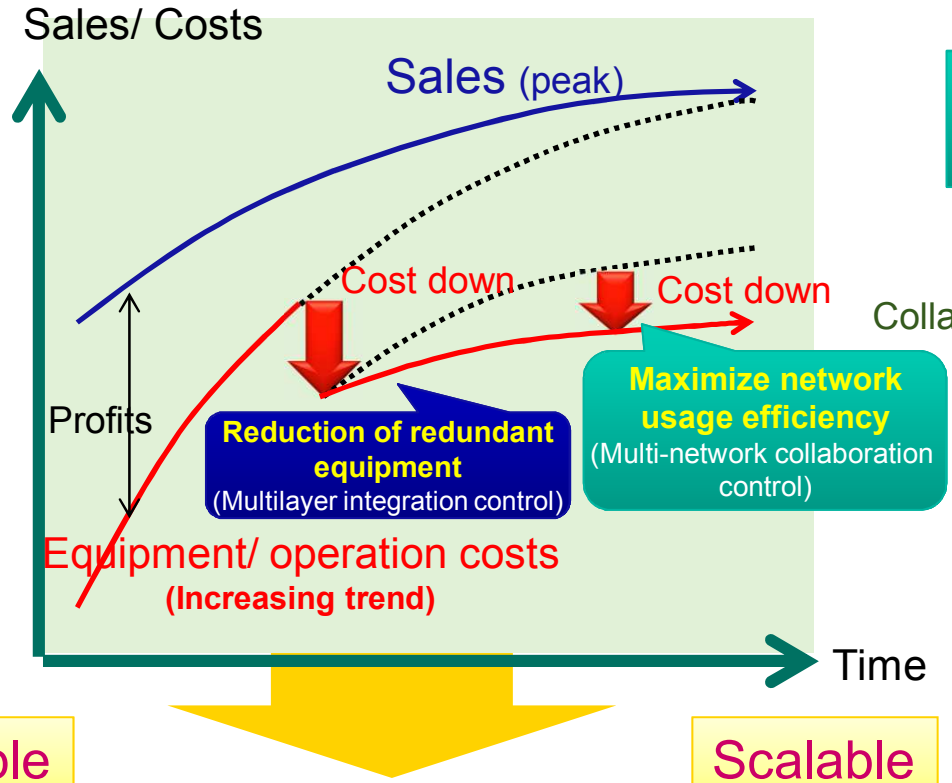
(4) Networking: Enabling Global Optimization by Expanding Scale

Networking

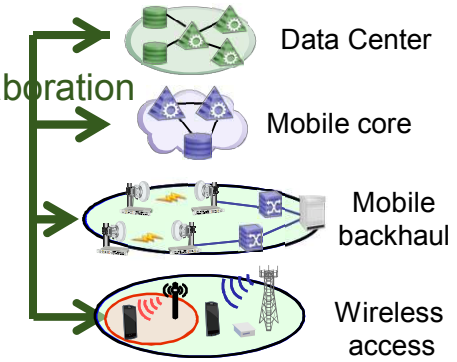
Realize dramatic improvement in operation efficiency and cost reduction by shifting from individual optimization to global optimization

① Multilayer integration control





② Multi-network collaboration control



Flexible

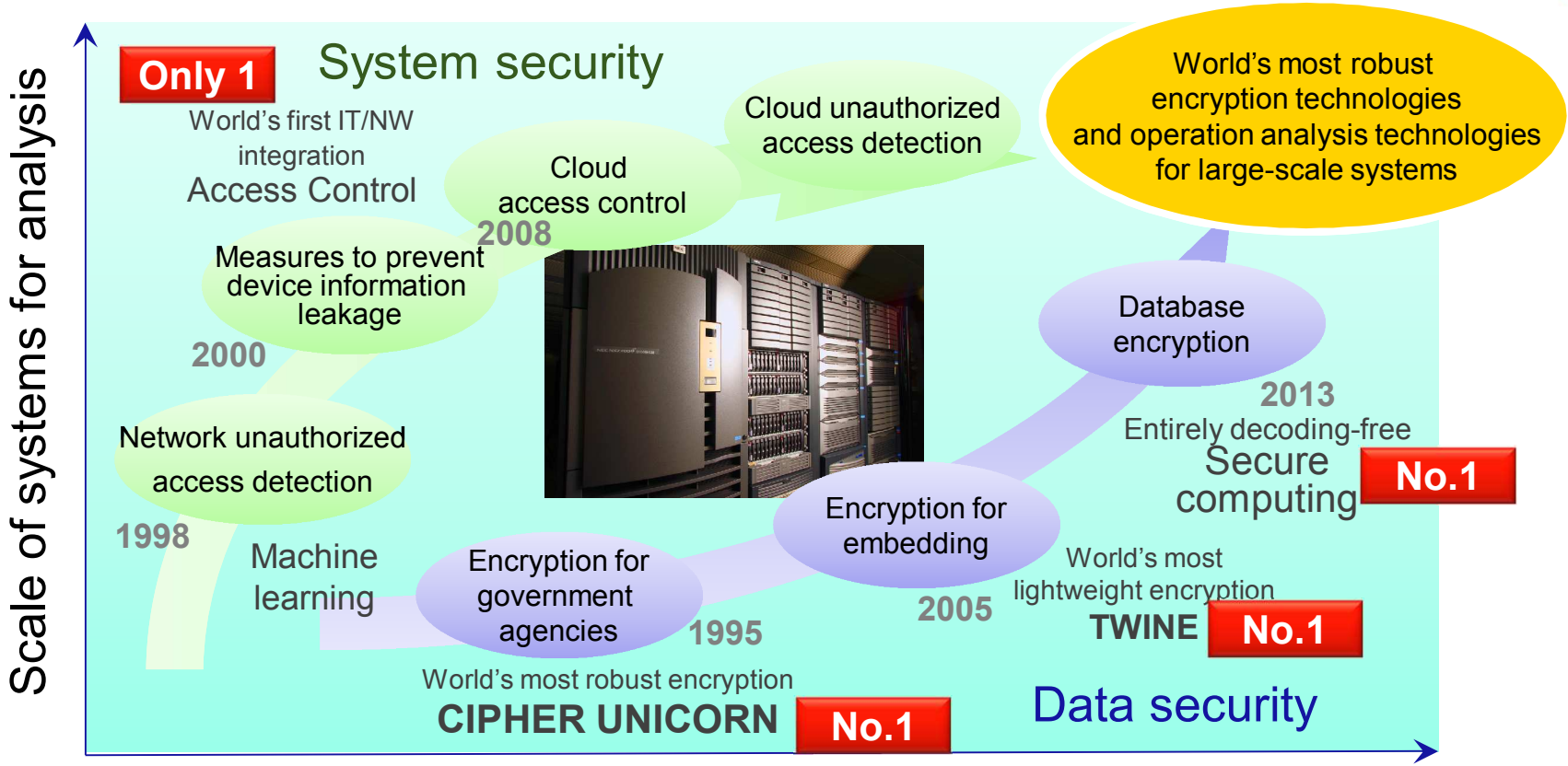
Scalable

Dramatic improvement in operation efficiency and cost reduction

Efficiency 効率 Equality 公平

(5) Security: Robust and Safe Security Technologies

Security

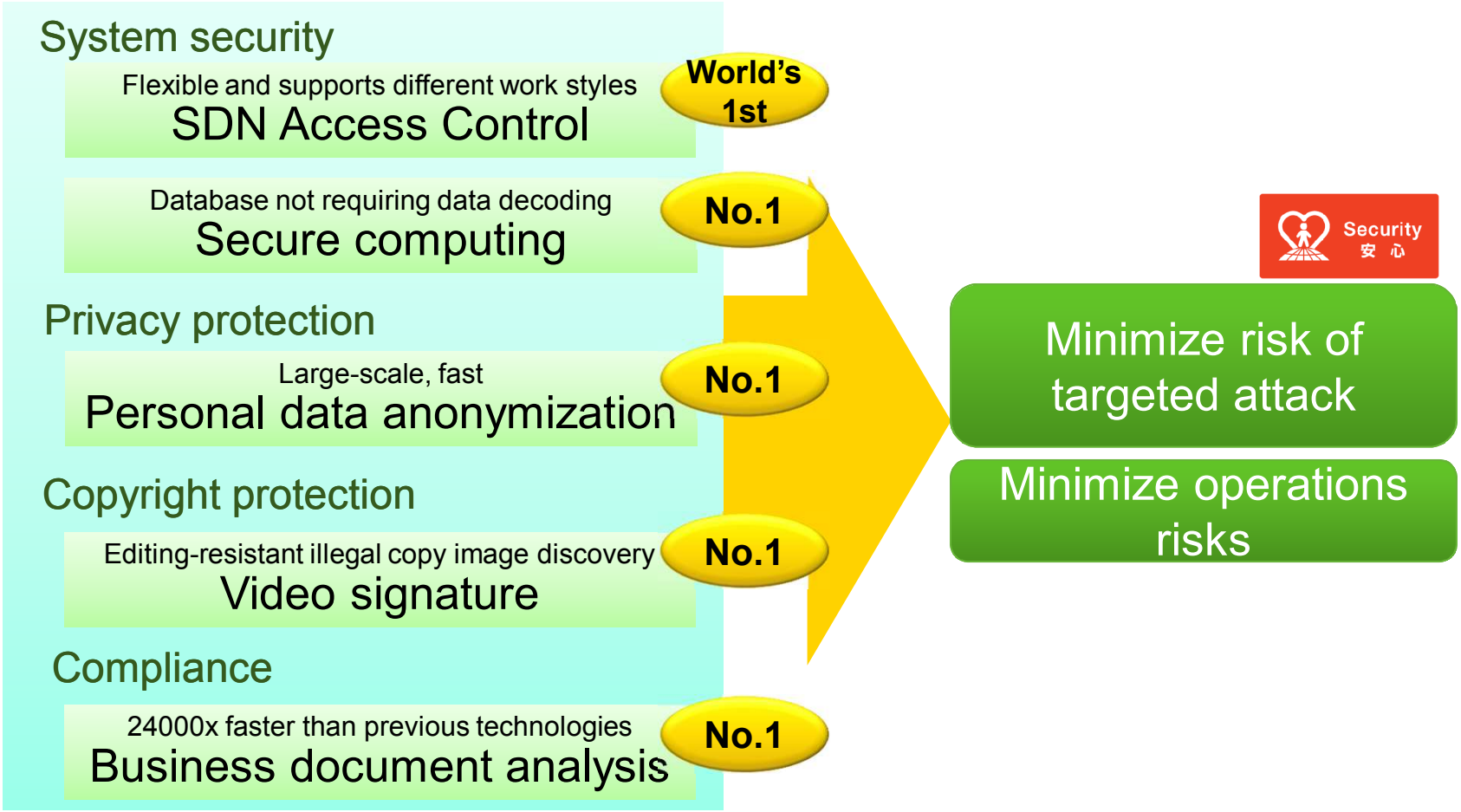


Build highly reliable system security platform through world's most robust encryption technologies and operation-analysis technologies for large-scale ICT

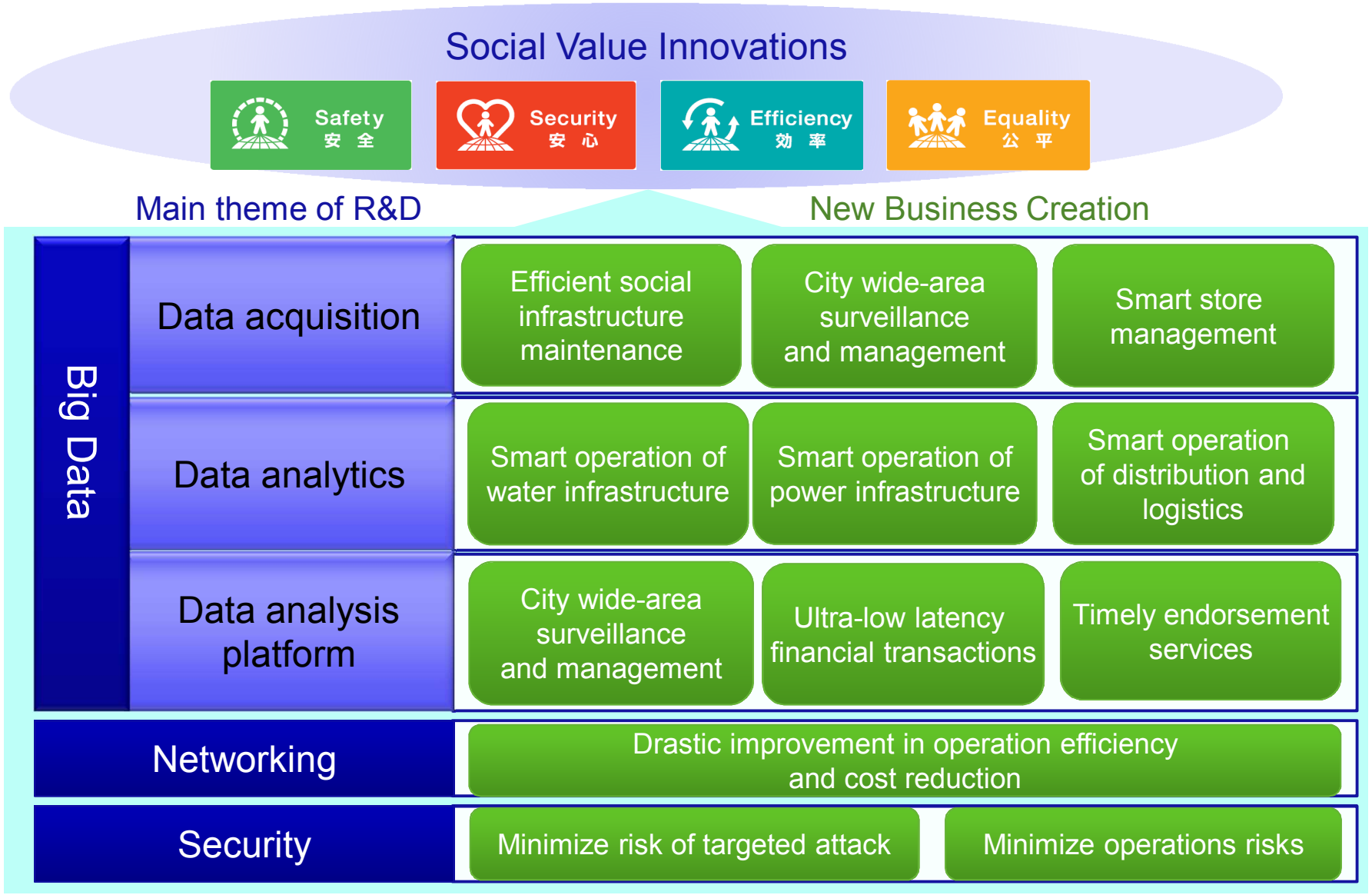
(5) Security: Responding to Increasingly Complex and Diverse Threats

Security

Respond to increasingly complex and diverse threats through system security platforms that utilize the world's most robust encryption technologies and large-scale-system analysis technologies



R&D for Innovation of Social Value



Contents

Maximizing the Efficiency of R&D Investments

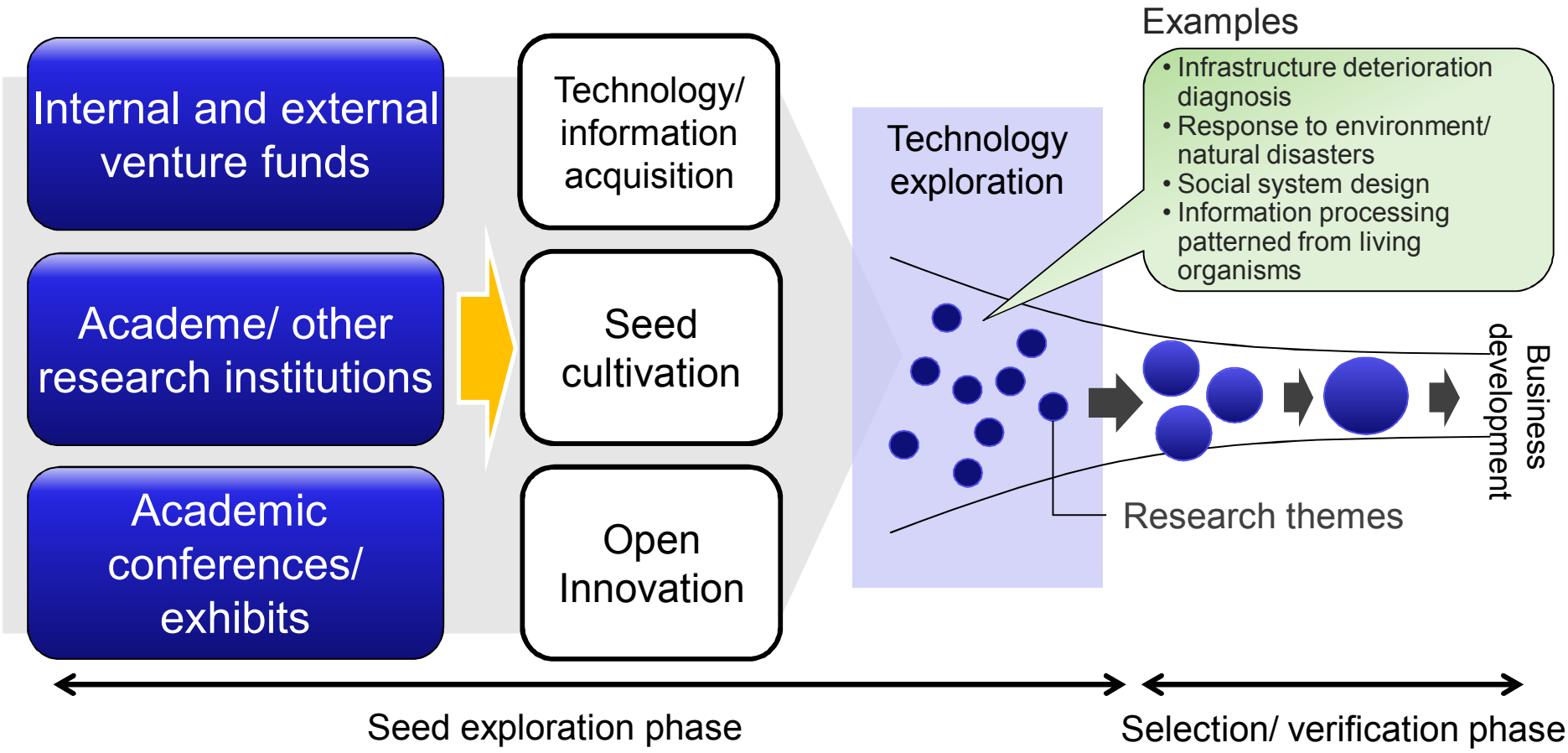
- Concentrate investments in focus research areas
- Reinforcement of exploration of new seeds

- Fast-track business development through collaboration with customers

- Initiatives towards fast-tracking global business expansion

Reinforcing Exploration of New Seeds

Reinforce exploration of new seeds centered on Open Innovation to enable creation of large-scale business for the next Mid-term Plan period (2015 onwards)



Examples of Creating value with Customers

Fast-tracking of business development through collaboration with customers

The Chugoku Electric Power Co., Inc.

Use of Invariant analysis technology
Detection of signs of plant anomalies

OBAYASHI CORPORATION

Use of Heterogeneous mixture learning technology
Power demand forecasting

Sumitomo Mitsui Banking Corporation

Use of Text analysis
Reinforcement of information governance

Mitsubishi Heavy Industries, Ltd.

Use of Heterogeneous mixture learning technology
Energy demand forecasting system for ships

Major retail companies

Use of Heterogeneous mixture learning technology
Merchandise automatic ordering

Reinforce on-site value-creation activities, including in-house trials

Initiatives Towards Fast-tracking Global Business Development

Promote globalization of R&D to reinforce deployment of products and solutions for overseas business

Concrete initiatives:

Field trials through collaborations with local customers in different global centers (Japan, America, Europe, China), as is being done in NEC Laboratories Singapore (established in September)

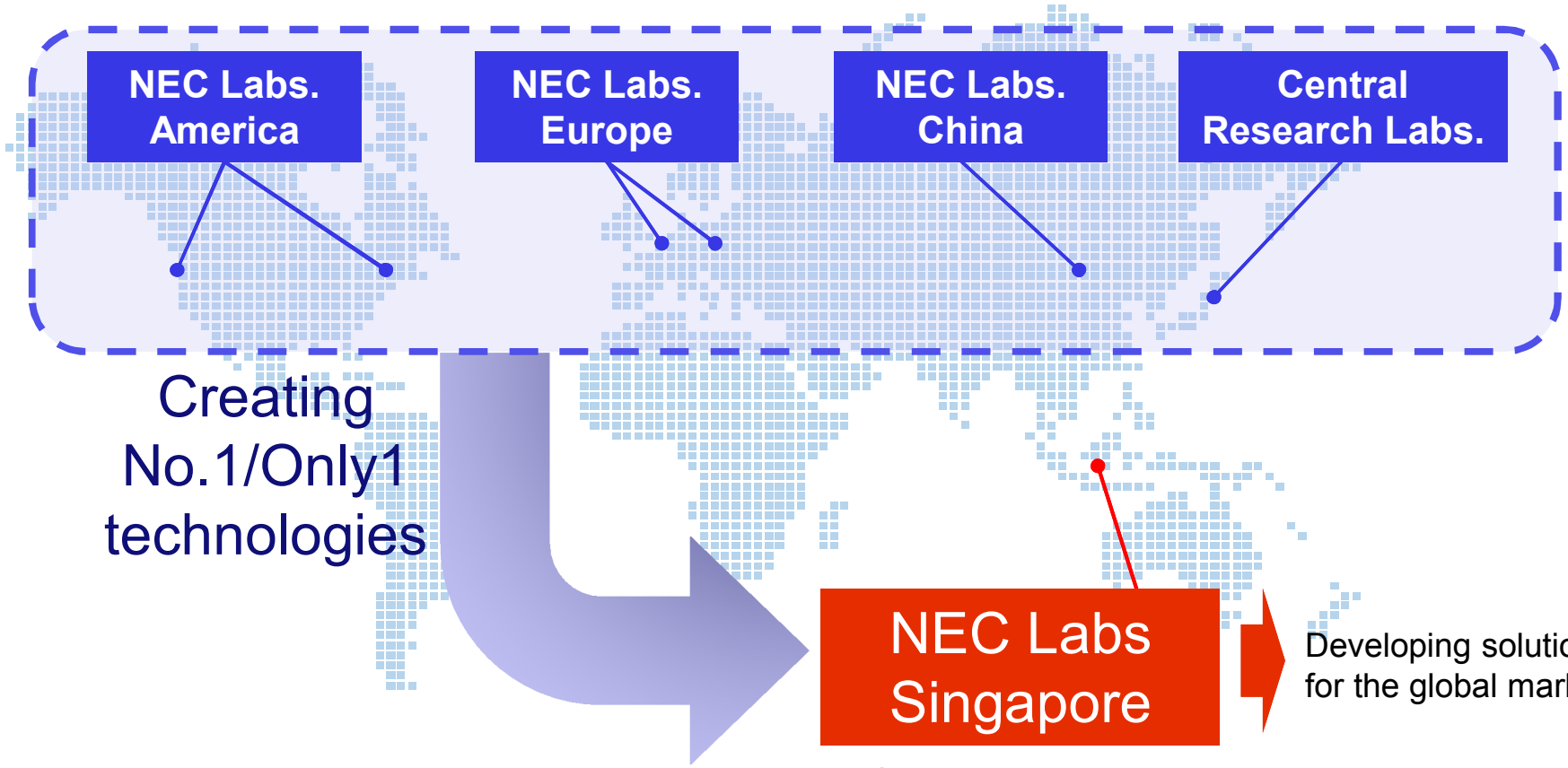
Advancement of R&D Ecosystem primarily centered on collaboration with universities

Promotion of hiring and training of global human resources

E.g.: Dispatch young researchers to emerging countries (Work-abroad program), direct hiring of talented personnel from local universities, etc.

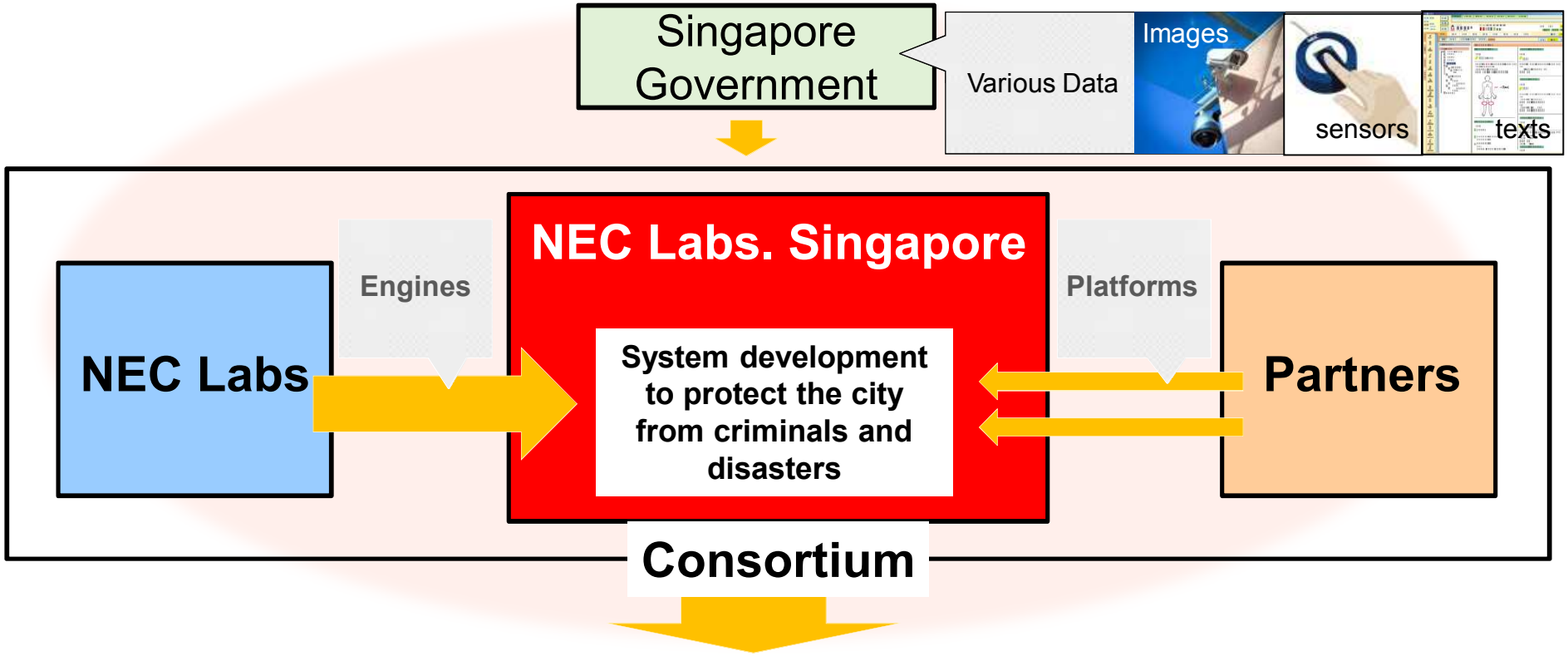
Initiatives Towards Global Business Expansion

New R&D for social value innovation



Example: Trial in Singapore, “Singapore Safe City Test Bed”

Leading a Safe City Test Bed Consortium to maintain safety and security in Singapore



Providing optimal operational services for the city through solutions based on advanced technology

Creation of Opportunities for Collaboration Towards Global Business Expansion: Smart Water Management

Collaborate with overseas customers and research institutions to resolve global social problems

Create future solutions (water management) from immediate problems (water leak detection) through collaboration with water supply companies

Joint research with Imperial College London on leak detection

Loss from leakage due to aging water pipes is a major social problem in advanced cities in Europe and America (London: 27%)

NEC

Water pipe deterioration diagnosis using vibration sensing technology

✖

Imperial College London

Water quality monitoring solution, water pressure sensors, etc.

Joint field trials for Water Management Solutions that include UK Water Companies

Water Companies

Data on degree of deterioration of pipes, water pressure, usage volume, and other data on the water pipe network

✖

NEC

Water demand forecasting solution using heterogeneous mixture learning technology

✖

Imperial College London

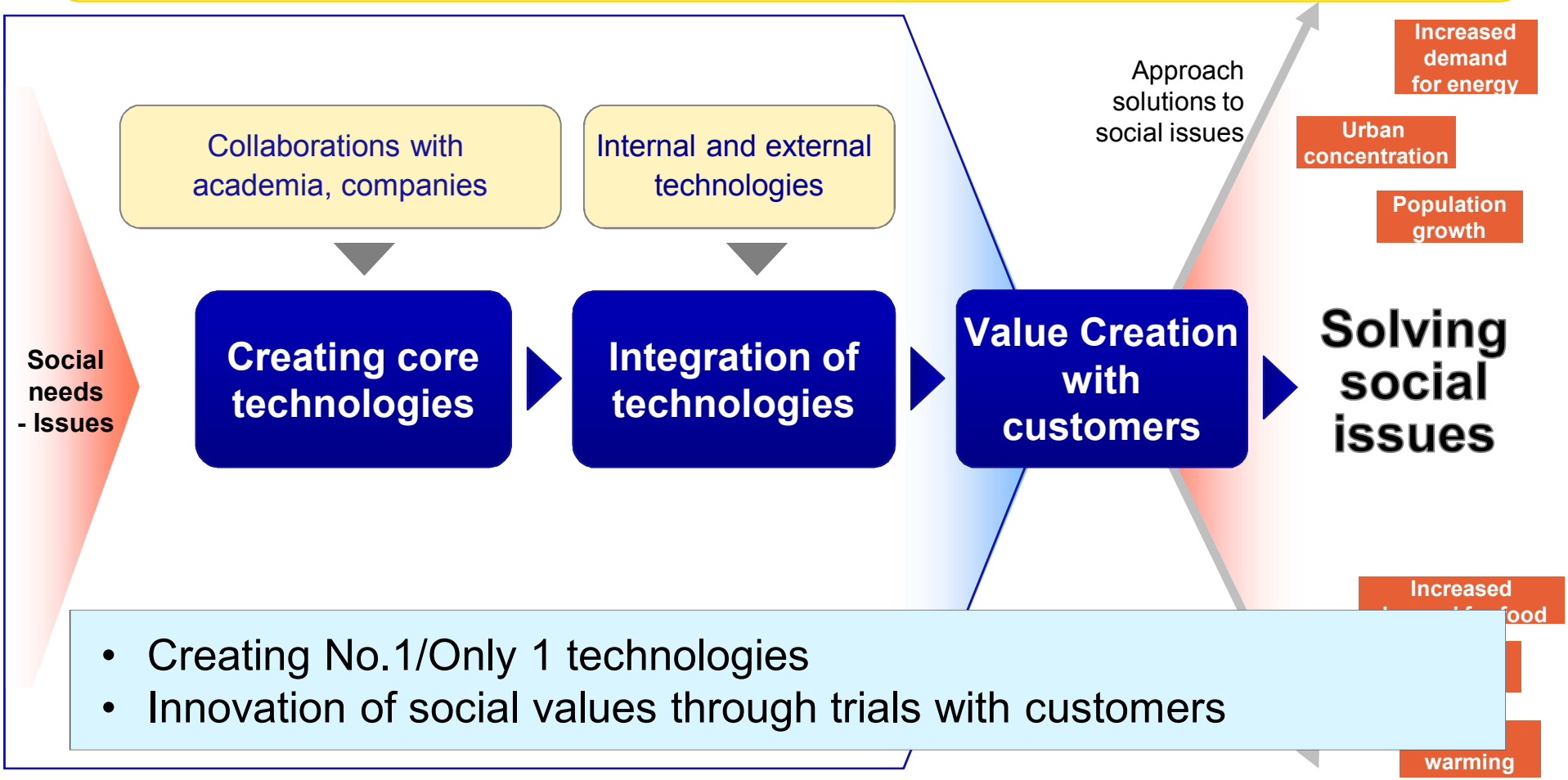
Water pressure remote control, modeling, and other water network control technologies

Management of entire water networks

Summary

NEC Laboratories collaborate with customers for new value creation

"Value Co-Creation Research Laboratories"



Empowered by Innovation

NEC

CAUTIONARY STATEMENTS:

This material contains forward-looking statements pertaining to strategies, financial targets, technology, products and services, and business performance of NEC Corporation and its consolidated subsidiaries (collectively "NEC"). Written forward-looking statements may appear in other documents that NEC files with stock exchanges or regulatory authorities, such as the Director of the Kanto Finance Bureau, and in reports to shareholders and other communications. NEC is relying on certain safe-harbors for forward-looking statements in making these disclosures. Some of the forward-looking statements can be identified by the use of forward-looking words such as "believes," "expects," "may," "will," "should," "seeks," "intends," "plans," "estimates," "targets," "aims," or "anticipates," or the negative of those words, or other comparable words or phrases. You can also identify forward-looking statements by discussions of strategy, beliefs, plans, targets, or intentions. Forward-looking statements necessarily depend on currently available assumptions, data, or methods that may be incorrect or imprecise and NEC may not be able to realize the results expected by them. You should not place undue reliance on forward-looking statements, which reflect NEC's analysis and expectations only. Forward-looking statements are not guarantees of future performance and involve inherent risks and uncertainties. A number of important factors could cause actual results to differ materially from those in the forward-looking statements. Among the factors that could cause actual results to differ materially from such statements include (i) global economic conditions and general economic conditions in NEC's markets, (ii) fluctuating demand for, and competitive pricing pressure on, NEC's products and services, (iii) NEC's ability to continue to win acceptance of NEC's products and services in highly competitive markets, (iv) NEC's ability to expand into foreign markets, such as China, (v) regulatory change and uncertainty and potential legal liability relating to NEC's business and operations, (vi) NEC's ability to restructure, or otherwise adjust, its operations to reflect changing market conditions, (vii) movement of currency exchange rates, particularly the rate between the yen and the U.S. dollar, (viii) the impact of unfavorable conditions or developments, including share price declines, in the equity markets which may result in losses from devaluation of listed securities held by NEC, and (iv) impact of any regulatory action or legal proceeding against NEC. Any forward-looking statements speak only as of the date on which they are made. New risks and uncertainties come up from time to time, and it is impossible for NEC to predict these events or how they may affect NEC. NEC does not undertake any obligation to update or revise any of the forward-looking statements, whether as a result of new information, future events, or otherwise.

The management targets included in this material are not projections, and do not represent management's current estimates of future performance. Rather, they represent targets that management will strive to achieve through the successful implementation of NEC's business strategies.

Finally, NEC cautions you that the statements made in this material are not an offer of securities for sale. Securities may not be offered or sold in any jurisdiction in which required registration is absent or an exemption from registration under the applicable securities laws is not granted.