Introduction to Technology

Panasonic

Technology

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01 Message from the Group CTO

Panasonic Holdings Corporation
Executive Officer
Group Chief Technology Officer (Group CTO)

Tatsuo Ogawa

We will develop and deliver technologies for a healthy Earth and happy lives of individuals.

For the realization of an ideal society offering material and spiritual affluence, the Panasonic Group aims to help individual customers stay healthy, safe, and comfortable throughout their lives while also deeming it necessary to implement measures against the progress of global warming and the depletion of resources as top management priorities.

Specifically, under Panasonic GREEN IMPACT, we will focus on measures for carbon neutrality and the circular economy. Also, in order to establish and make effective use of a technology platform comprised of AI, security and other systems to help people lead healthy, safe and comfortable lives, and to create new businesses, I will oversee technology-related issues and lead the development of human resources to add a new source of competitiveness for the Group's businesses.

Look ahead to the “Future,” keep taking on challenges

PHD | Panasonic Holdings Corporation

Corporate Strategy Sector

- Technology Strategy Group

Technology Sector

- Technology Planning Office
- Business Development Office
- Center for Better Employee Experience
- Technology Division
- Manufacturing Innovation Division
- Platform Division
- Corporate Intellectual Property Division
- Product Analysis Center

02 Organizational Structure for R&D Activities

PC	Panasonic Corporation	Design Division
CNA	China & Northeast Asia Company	Engineering Division
LAS	Living Appliances and Solutions Company	Living Products Innovation Division / DX, Customer Engagement
HVAC	Heating & Ventilation A/C Company	Innovation Center / Global Platform Development Center
CCS	Cold Chain Solutions Company	Solution Businesses Promotion Department
EW	Electric Works Company	Solution Development Division / R&D Division / Field Engineering and Manufacturing Innovation Division
PAS	Panasonic Automotive Systems Co., Ltd.	R&D Division
PEAC	Panasonic Entertainment & Communication Co., Ltd.	Direct Control Division (R&D)
PHS	Panasonic Housing Solutions Co., Ltd.	Innovation Division
PCO	Panasonic Connect Co., Ltd.	R&D Division / Manufacturing Innovation Division
PID	Panasonic Industry Co., Ltd.	Engineering Division
PEC	Panasonic Energy Co., Ltd.	Cell Development Division / System Development Division / Energy Research & Development Center

An ideal society with affluence both in matter and mind

Loss of biodiversity	Waste issues	Depletion of resources	Global warming	Urbanization, depopulation	Extension of healthy life expectancy	Use of surplus time	Diversification of needs

Solving global environmental issues Panasonic GREEN IMPACT

Life-long health, safety and comfort for everyone

Creation of new business opportunities / Enhancement competitiveness of business

Core Technology Platform

Specification of Core Technologies as a Source of Competitiveness, and Enhancement of the Technologies through Collaboration across the Group

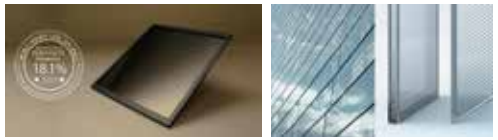
		PC	PAS	PEAC	PHS	PCO	PID	PEC
Technologies that contribute to solving global environmental issues	Functional materials & materials informatics	○	○		○		●	●
	Power electronics	○	●				○	
	Hydrogen energy devices & DERMS	●	○				○	○
Technologies that contribute to the life-long health, safety and comfort for everyone	CPS & AI	●	●	●	○	●	○	○
	Image sensing & robotics	○	●	●		●	●	
	Simulation & model-based development	○	●	○	●	○	○	○
	Biometrics & emotion recognition	○	○		○		○	
Common software platform	Software, communication & security	●	●	●	○	●	○	

● Strongly related ○ Related

Carbon neutral

Perovskite solar cells

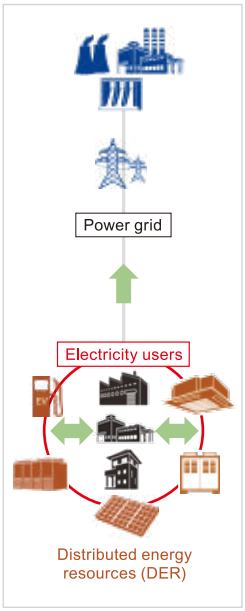
- Solar cells that can be installed even in places where conventional models would be unacceptable, such as on the windows of buildings, and are thus harmonious with community and daily life
- Achievement of the world's highest-level 18.1% energy conversion efficiency for a perovskite solar cell module
- Large cells that provide flexibility in size with high energy conversion efficiency due to the adoption of unique inkjet coating technology and materials technology



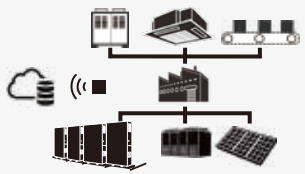
Decarbonization solution based on the management of distributed energy resources

- Supply-demand balance adjustment made between users of electricity and power grid operators through the creation and expanded use of clean energy and the promotion of electrification
- Provision of a package of technologies for the maximum use of DER* based on expertise as a user of electricity
- Development of integrated technologies and platform to connect DER* to social infrastructure

* Distributed Energy Resources

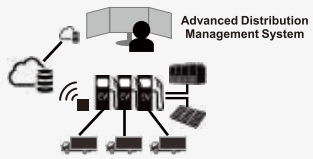


VPP and RE100 solution



- Transform a factory into a virtual power plant (VPP) through the management of cooling & production equipment
- Achieve "RE100" by the integrated management of solar cell, fuel cell and storage battery systems

EV charging infrastructure solution
(for transportation companies and electric power companies)

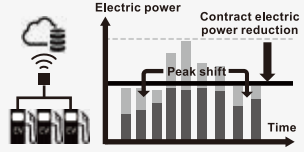


- Control quick charging devices in line with the actual power distribution network situation at the charging facilities of transportation companies

System for the integrated use of multiple hydrogen fuel cells

- Make integrated use of multiple pure hydrogen fuel cells for larger output, variable output, higher efficiency, larger electricity generation capacity and longer life

EV charging infrastructure solution
(for companies and local governments)

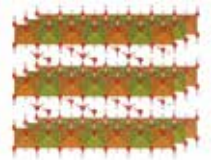


- Control EV charging devices for peak shift, thereby reducing the capacity agreed with the power supplier

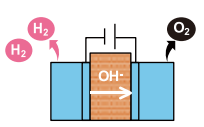
Green hydrogen manufacturing device

- Development of Panasonic's unique nonprecious-metal highly active anode material (NiFe-LDH)
- Hydrogen manufacturing efficiency (of 74.7%@1A/cm2 on a laboratory level) proven with anion exchange membrane water electrolysis
- Development under way for the application of this material technology for an anode material for alkaline water electrolysis

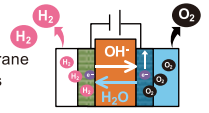
Fine and layered double hydroxide made of nickel and iron

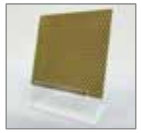


Anode material for alkaline water electrolysis



MEA for anion exchange membrane water electrolysis

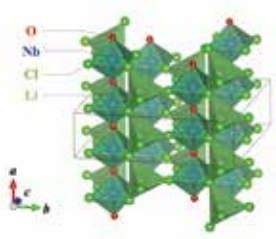




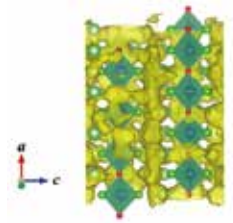
*MEA: Membrane Electrode Assembly

All-solid-state battery

- Battery that outstrips conventional lithium-ion secondary batteries in terms of output, brevity of charging time, and safety and security
- Unique solid electrolyte developed by Panasonic by using halide with high ionic conductivity
- Development of a high-speed ionic conductivity evaluation method by taking a computational science-based approach for automatic diffusion path search



Crystalline structure of the developed halide-based solid electrolyte, and intracrystalline lithium-ion conduction path



Making “environment-conscious planning” and “operation for efficient production” compatible On-site Cyber-Physical System (CPS)

- On-site optimization: Simulation to minimize CO_2 emissions and maximize profit
- On-site visualization: Automatic observation of the movements of people, things and equipment and automatic identification of bottlenecks
- Total optimization: Operation consulting

On-site visualization Real-time visualization of performance through digitalization

1 On-site filming by using an on-site CPS kit

2 Real-time digitalization

- Ultra-high-speed AI learning
- Superlight AI camera
- Ultra-precision probability model

3 Visualization of inefficient operations

Transformation of IE know-how into explicit knowledge

Dashboard

Nature-positive

Bio CO_2 Transformation to accelerate the growth of plants

- Application of unique microbial technology for the effective use of atmospheric CO_2, which can be procured in unlimited quantities, to realize economically rational production of commercial products
- Activation of energy metabolism through photosynthesis-based cell metabolism to increase yield, stabilize production and enhance immunity
- Simple spraying onto leaves and no need to make substantial changes to or large capital investments in conventional agricultural work

Bio CO_2 reactor

CO_2 →

Light →

Transgenic photosynthetic microorganism (cyanobacteria)

Plant growth promoting agent “Novitek”

Spinach cultivation (spraying the agent onto leaves)

40.9% increase in yield due to spraying

Circular economy

Automating the recycling of home electrical appliances for a circular economy

- Identification and removal of screws even where there is rust or stains
- Careful disassembly of the cover of an outdoor unit by a robot imitating the movements of an experienced worker
- Efficient operation by building a database of the numbers and locations of screws used in various outdoor units

Advancing the recycling of home electrical appliances!

System to automatically disassemble the cover of an air conditioner outdoor unit

Plant-derived sustainable material: Cellulose-based material

- Lighter and stronger than conventional petroleum-based resin due to the use of cellulose
- Performance on par with that of conventional petroleum-based resin
- Usability of a conventional petroleum-based resin molding machine
- Development under way to make the resin, including binder resin used in it, 100% biodegradable

kinari

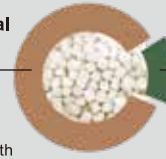
Adding plant fiber at high concentrations

Plant-based highly functional material that contains cellulose fiber at a rate of up to 85%

Composition of Kinari

Plant-based material (Cellulose) 85%*

*Ratio by weight (Experimental value)
*Already put on sale with a concentration of 70%



Binder resin

Petroleum-based

Plant-based biodegradable binder resin under development

Can be made from waste materials

Various types of green and organic waste, which would otherwise be disposed of, can be used as materials.

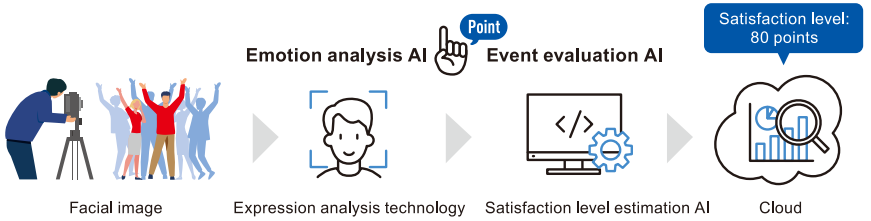
These are just some examples

- Lumber from forest thinning
- Clothes made from natural materials
- Seaweed and algae
- Wooden barrels
- Waste paper
- Coffee grounds
- Straw and agricultural residues
- Pomace and the like

Helping people lead fulfilling lives right to the end

User experience (UX) management through emotion visualization and facial expression analysis

- Quantification of users' facial expressions for real-time emotion recognition
- No need for questionnaires, as data can be obtained from users' unconscious responses



Operational support robot-based solution fit for various situations

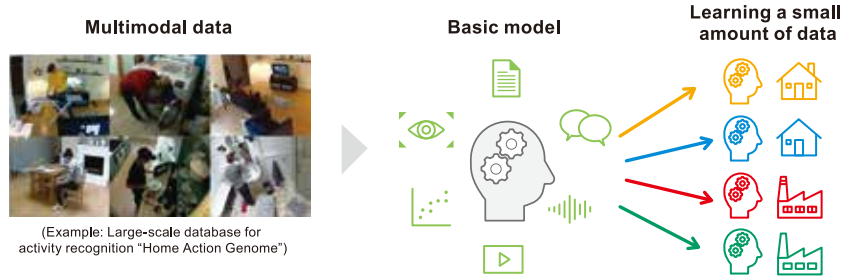
Creation of a future community where people live in harmony with robots

- Better service continuity based on a remote-control system that enables the operation of four units by one person
- Realization of a running platform that ensures safety and security even in an environment that includes both people and robots
- Support for service introduction and better operation based on risk-conscious simulation

Society where people can lead vibrant live

Scalable AI: Prompt delivery to all customers

- Establishment of a "basic generative AI model" as the basis for all learning
- Introduction of an AI system with the addition of a small amount of data and with the development period cut to one-fifth relative to the past



Voluminous data encompassing the Panasonic Group's wide range of businesses

Providing customers with an optimal AI system with the addition of only a small amount of data

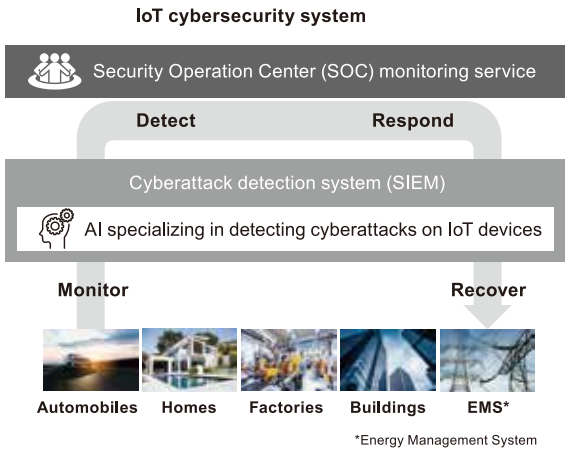
Responsible AI: Proving worthy of all customers' trust

- Achievement of "Responsible AI" based on reliable technologies
- Enhancement of AI ethics and governance through company-wide education and checking systems

Common Software Platform

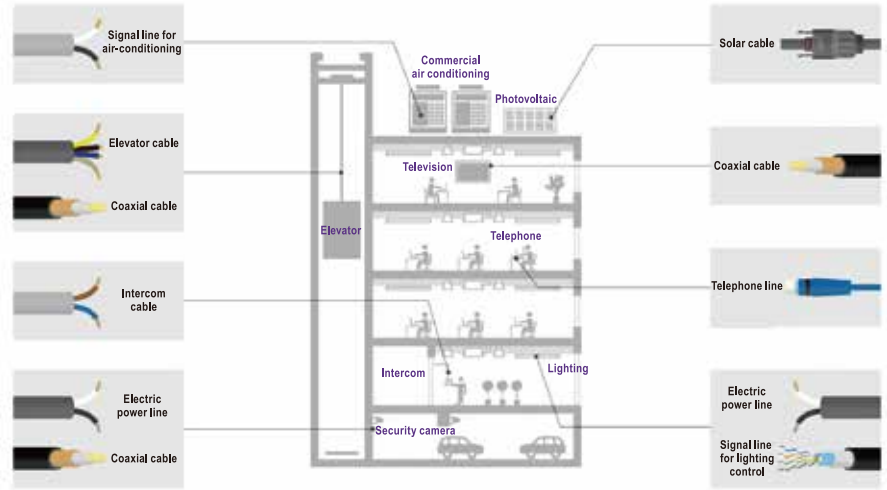
IoT cybersecurity monitoring system

- AI-based cyberattack detection technology that focuses on the control commands and networks of IoT devices
- Cyberattack detection system that visualizes attacks and saves time/labor on related analysis



Secure IoT network of several hundred units that can be built without new wiring work

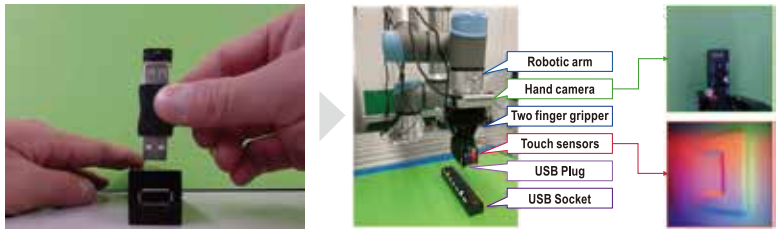
- Easy installation (at a low cost) by the use of existing lines
- Realization of an IP network of several hundred units, which is required for large-scale communication infrastructure for buildings, etc.
- Renovation of existing infrastructure to create a secure and high-speed communication network



Automating precision work by fusing visual and touch sensors

AI-based reproduction of the advanced visual and touch sensing activities that are conducted unconsciously by humans

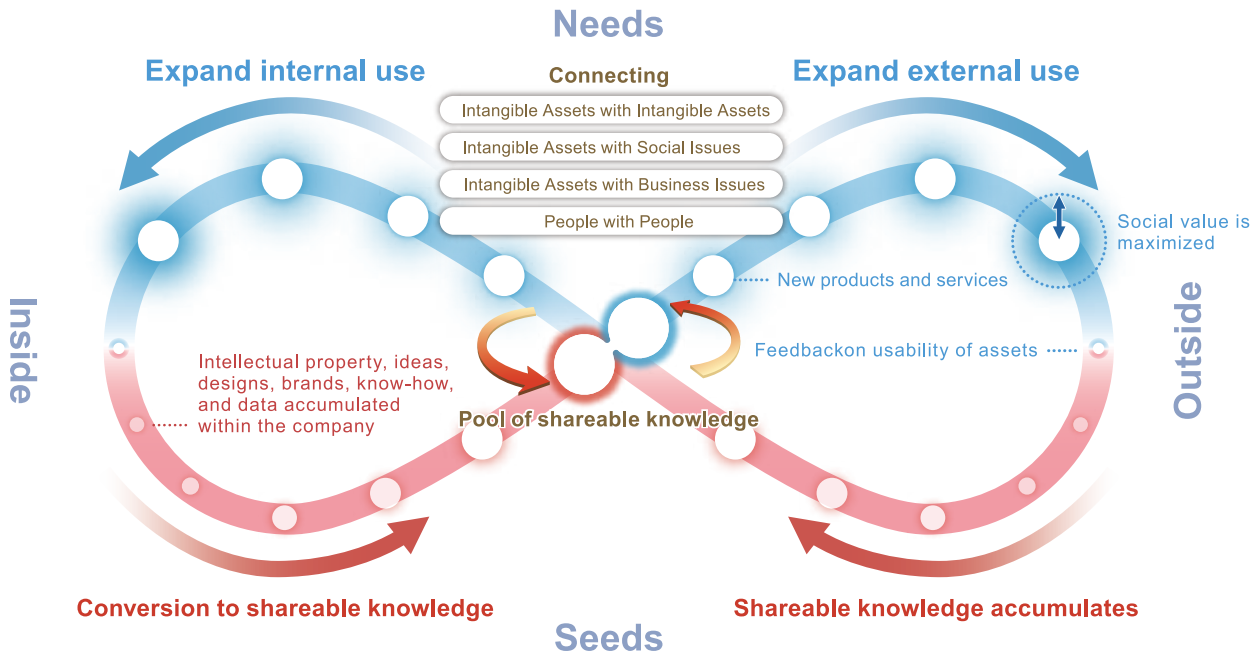
- Precise recognition of the socket location by visual sensing
- Recognition of the position of the plug held with the fingertips
- Calculation of the insert position with submillimeter precision



Wireless transmission system that does not require battery replacement or power supply cables

- Long-distance power transmission for the delivery of electricity to places unsuitable for wiring
- Simultaneous power transmission to multiple devices to eliminate the need for battery replacement
- Small footprint for installation even in tight spaces

IP Innovation to add value to intangible assets and bring more happiness to the world



Intangible assets are the lifeblood of society and can improve people's lives.

Just as blood circulates in your body and revitalizes you from head to toe, intangible assets are the revitalizing lifeblood of a dynamic society. We will foster the appropriate use of intangible assets—both our own and the world's—and work with a range of stakeholders to add social value to them, thereby creating a sustainable society as a precondition to bringing more happiness to people around the world.

Technology Index

For easy search of specific technologies

It is necessary to make use of a range of technologies to solve global environmental issues and help individuals lead happy lives.
Through the Technology Index initiative, we are working to provide opportunities for open innovation and the solution of social issues by introducing a range of technologies in a way that makes it easy for users to find a specific technology to meet their needs.

We look forward to receiving your inquiries about technologies that interest you.

Technology Index:
Initiative by the intellectual property department
Panasonic Holdings
(holdings.panasonic)

Japanese website only

Training ourselves by various measures as well as conducting joint research activities with various universities and research institutions, and creating innovative new products and business models

External Activities Related to Academic Societies and Industrial Policy

Academic society activities and paper submission

- Taking on the challenge of the world's top-level publications (Nature, Science, ECCV, etc.)

Standardization activities

- Setting up sites in North America, Europe, China, and Singapore to promote standardization activities globally
- International Standard: IEC (electrical and energy system), ITU (communication system), ISO (automotive & robotics etc.)
- Forum/Consortium: 3GP (5G/6G), CSA (IoT), WBCSD (Avoided Emission, Carbon Footprint)
- Global government policy: European Commission (Green by Digital), China (new energy car)

Joining in national projects in Japan

Cabinet Office	Cross-ministerial Strategic Innovation Promotion Program (SIP)
Ministry of Education, Culture, Sports, Science and Technology	JST* Research and development program of basic research and core technology (Moonshot, CREST, A-STEP etc.)
Ministry of Economy, Trade and Industry	NEDO* energy / environmental technology, and industrial technology projects
Ministry of Internal Affairs and Communications	Research and development for information and communication technology

* JST: Japan Science and Technology Agency
* NEDO: New Energy and Industrial Technology Development Organization

Open Innovation

Joint research: Universities and research institutions worldwide

Outside Japan	■ imec (Belgium), MIT (USA), Stanford University (USA), TNO (Netherlands) etc.
Inside Japan	■ Cooperation with over 400 national research institutes and university laboratories ■ Panasonic research centers have been established on campuse s at The University of Tokyo, Kyoto University, Osaka University, Kyushu Institute of Technology, University of Fukui, and joint researches are carried out

Collaboration and Co-creation: Breaking away from self-reliance / Emphasis on speed / Win-win relationship building

- Establishment of New Business Creation Schemes
- Make IP information “Intangible Asset" and co-create with partners

Challenge Activities

Support for corporate culture reform and co-creation

- Creating new experiences by supporting the challenges of diverse employees

EXL (EX Lab)

Panasonic Laboratory Tokyo

Promotion of innovation

- World-class technology and business leaders, mainly in Silicon Valley, create new products and services with a sense of speed and initiatives.
- Contributing global innovation and business growth by organic linkage between business, technology, and creativity

07 Global R&D Map

Europe

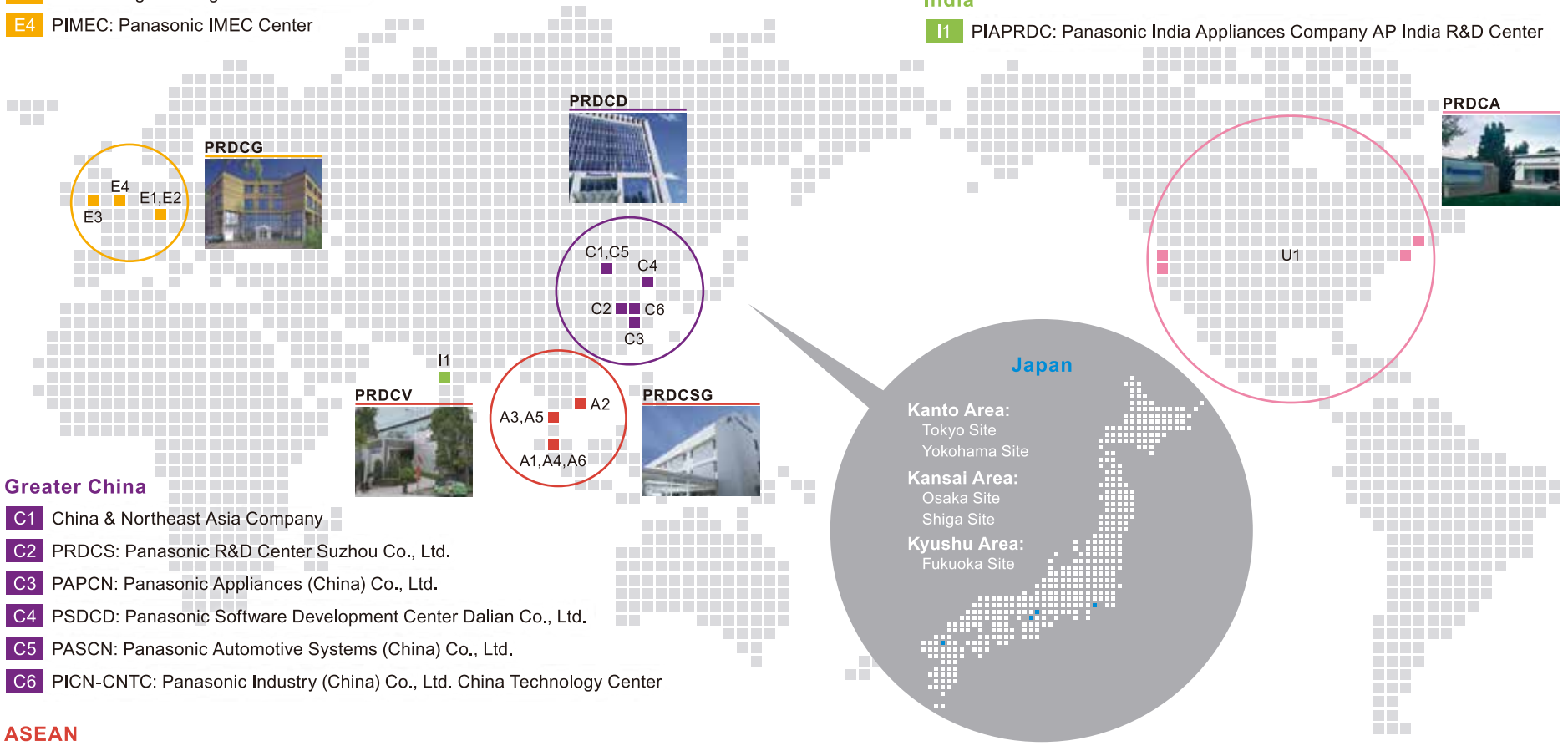
- E1 PRDCG: Panasonic R&D Center Germany, GmbH
- E2 PLDC: Panasonic Langen Development Centre
- E3 IDSC: Integrated Digital Service Center
- E4 PIMEC: Panasonic IMEC Center

North America

- U1 PRDCA: Panasonic R&D Company of America, Division of Panasonic Corporation of North America

India

- I1 PIAPRDC: Panasonic India Appliances Company AP India R&D Center



Greater China

- C1 China & Northeast Asia Company
- C2 PRDCS: Panasonic R&D Center Suzhou Co., Ltd.
- C3 PAPCN: Panasonic Appliances (China) Co., Ltd.
- C4 PSDCD: Panasonic Software Development Center Dalian Co., Ltd.
- C5 PASCN: Panasonic Automotive Systems (China) Co., Ltd.
- C6 PICN-CNTC: Panasonic Industry (China) Co., Ltd. China Technology Center

ASEAN

- A1 PRDCSG: Panasonic R&D Center Singapore, Division of Panasonic Asia Pacific Pte. Ltd.
- A2 PRDCV: Panasonic R&D Center Vietnam Co., Ltd.
- A3 PAPARADMY: Panasonic Appliances Air-Conditioning R&D (M) Sdn. Bhd.
- A4 PIDSG-SGTC: Panasonic Industrial Devices Singapore, Singapore Technology Center
- A5 PAPRADAP: Panasonic Appliances R&D Centre Asia Pacific Sdn. Bhd.
- A6 A6 PAPRADSG: Panasonic Appliances R&D Center Singapore

Panasonic

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