NATIONAL AI RESEARCH INSTITUTE
MAKING A BETTER TOMORROW

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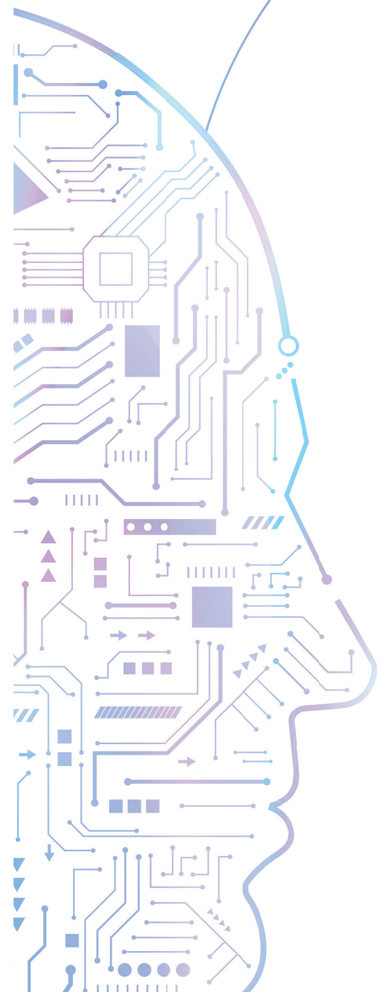

ETRI
Electronics and Telecommunications Research Institute

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ETRI

NATIONAL
AI RESEARCH INSTITUTE
MAKING A BETTER
TOMORROW

We create the future
by creating and challenging

Waves of new technologies such as AI, Big Data, Block Chain, cloud, and IoT are moving quickly;
thanks to these technologies, we are currently enjoying lifestyles that are very different from the past.
ETRI works hard to realize the values that we can enjoy through technology.
ETRI develops technologies that open a new era for the common people.

We improve humanity's quality of life through ICT convergence

The future of our imagination has already arrived at our doorstep.
The autonomous driving that we had always dreamt about is spurring
the freedom of our movements, and translation machines that break down language barriers and
5G that connects people with things have become a reality.
ETRI's efforts to provide a more comfortable, convenient life for people will never stop.

PRESIDENT MESSAGE

Today, we are living in the age of a great revolution called the 4th Industrial Revolution. This revolution is sometimes also referred to as the “Age of Digital Transformation” or the “2nd Period of the Information Age.” Regardless of the term used, the key enabling technology is ICT. Collectively called ABCI, Artificial Intelligence(A), Big Data(B), Cloud computing(C), and Internet of Things(I) are all ICT.

Therefore, we at ETRI are aware of the immense responsibility because our organization presides over all ICT research and development efforts sponsored by the national government. As a tool of innovation, ICT is not only intellectualizing the structure of industries from manufacturing to defense, medical care, culture, education, and agriculture/livestock/fishing industries but will enhance the individual lives of people in safe, convenient ways. The approximately 2260 employees of ETRI are diligently and strongly devoted to carrying out research to realize this national calling.

ETRI plans to acquire global technological competitiveness through the development of hyper-connected intelligent infrastructure technology and lend support to the innovative growth of the country. At the same time, based on ICT, we will contribute to the creation of a safe social environment that people can trust with peace of mind. We also wish to help build a nation that overflows with the spirit of caring through the development of “people-friendly” ICT that could be used in creating a people-oriented digital society.

ETRI is continuously committing its resources to R&D efforts that could lead to a better future, a safer environment, and a comfortable life. We will become a research institute beloved by the public, trusted by the government, and acknowledged by our customers.

We would appreciate your encouragement and advice in helping ETRI go beyond Korea to the rest of the whole world. Inspired by public expectations, we shall respond by becoming a national research institute that can lead the future of humanity and the country through collaborations with domestic and international experts. We intend to become a smart partner of the Korean people.

Thank you.

President of ETRI Kim, Myung-Joon

We shall become
a total research institute for
national intellectualization and
a making a better tomorrow.

HISTORY

1976 · 1980 · 1990 · 2000

1976.12.30.

KERTI established
Established for electric research and testing

KIET established
Established for semi-conductors and computers

1976.12.31.

KECRI was founded as an affiliate of KIST
Established for R&D in telecommunications technology

Established KERTI, KIET and KECRI, the origins of ETRI

Dec. 30, 1976 : KIET(Korea Institute of Electronics Technology)was established

Dec. 30, 1976 : KERTI(Korea Electric Research and Testing Institute)was established

Dec. 31, 1976 : KECRI(Korea Electronics & Communications Research Institute) was founded as an affiliate of KIST

1977.12.10.

KTRI established
KECRI became independent from KIST and KTRI was established on Dec 31, 1976 as a research institute specialized in telecommunications

Dec. 10, 1977 : Independent from KIST and renamed itself as KTRI

1981.01.20.

KETRI established
(consolidation of KTRI and KERTI)

Established KETRI

Jan. 20, 1981 : KETRI(Korea Electrotechnology and Telecommunications Research Institute) was established in consolidation of KTRI and KERTI

1985.03.26.

ETRI established
ETRI Institute specialized in information and telecommunications(consolidation of KIET and KETRI)

Established ETRI

March 26, 1985 : ETRI, institute specialized in Information and Telecommunications was established(consolidation of KIET and KETRI) to meet with the emphasize on electronics field

1996.01.01.

SERI transferred to ETRI
SERI, data process department of KIST, transferred to ETRI as an affiliate

Data process department of KIST transferred to ETRI as an affiliate

June 27, 1967 : SERI(Systems Engineering Research Institute) was opened as data process department of KIST. In accordance with, government restructuring of the Ministry of Science and Technology to the Ministry of Information and Communication SERI became affiliate of ETRI on January 1, 1996.

May 25, 1998 : Incorporated into ETRI

1997.01.31.

ETRI
ETRI's Korean name changed

ETRI's Korean name changed

Jan. 31, 1997 : Based on regulations for electronics and telecommunications

R&D MAJOR ACHIEVEMENT

ETRI makes contribution to the nation's economic and social development through research, development and distribution of industrial core technologies in the field of Information, Communications, Electronics, Broadcasting and Convergence technologies.

1970s

1976
- Established ETRI, an affiliate of KIST
- Established KIET
- Established KERTI

1977
- Established KTRI (Korea Telecommunication Research Institute)

1980s

1982
- The nation's first semiconductor product '32K ROM chip'

1983
- 8-bit educational computer

1984
- 16-bit UNIX domestic computer

1986
- Developed the telephone exchange system(TDX) that opened the era of 1 telephone per household in South Korea

1988
- 565Mbps optical communications system

1989
- 4M, 16M, 64M and 256M DRAM

1990s

1990
- 32-bit microprocessor

1991
- Launched TDX-10
- TiCOM II

1995
- Commercialize CDMA for the first time in the world

1996
- CDMA ATM exchanging machine

1999
- Synchronized IMT 2000(CDMA2000) STP system

2000s

2004
- Developed the world's first prototype system of wireless broadband Internet called WiBro

2005
- ETRI succeeded in exported embedded SW solution
- Terrestrial DMB service launched

2006
- Developed a wireless home network(UWB)
- Developed the world's first transparent AMOLED

2007
- The world's first 3.6Gbps 4th generation mobile communication technology(NoLA)

2008
- Developed an SMMD-based live experience 4D system technology

2009
- Developed eco-friendly OLED lighting technology for illuminating the world

2010s

2010
- 4G LTE-Advanced Technology
- Smart ship technology(SAN)

2011
- Transparency adjustable AMOLED display
- Packet-optical integrated transport network technology

2012
- Developed optical Internet technology that's 100 times faster
- Developed a mobile Korean-English translating technology called Genie Talk

2013
- Automated valet parking technology using a smart phone

2014
- OCESTRA, Optical Internet technology

2015
- Developed technology for constructing optical large-capacity mobile communication base stations

2016
- Developed language intelligence SW EXOBRAIN

2017
- Developed UHD mobile broadcasting technology.
- Developed mobile hotspot network(MHN) technology capable of GIGA-level data transmissions

2018
- Tactile Internet Technology (TIC-TOC)

VISION

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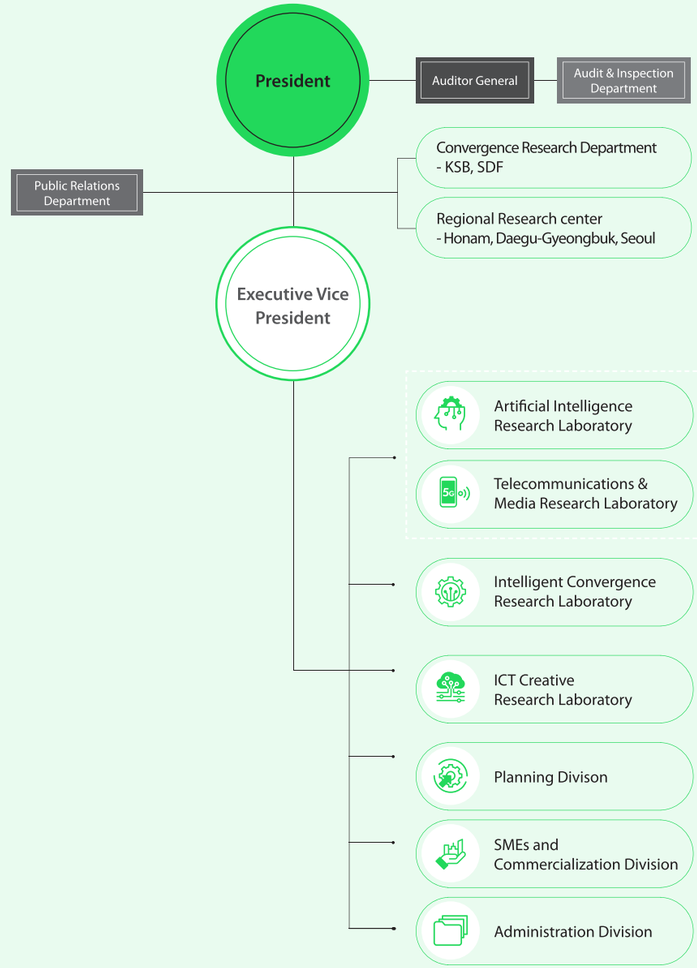
Your Trusted Partner, Leading ICT,
Creating a Better Future

MANAGEMENT PRINCIPLE

ORGANIZATION



1 Executive Vice President, 4 Research Laboratory, 3 Division, 2 Research Department, 3 Research Center, 1 Department

Electronics and Telecommunications
Research Institute

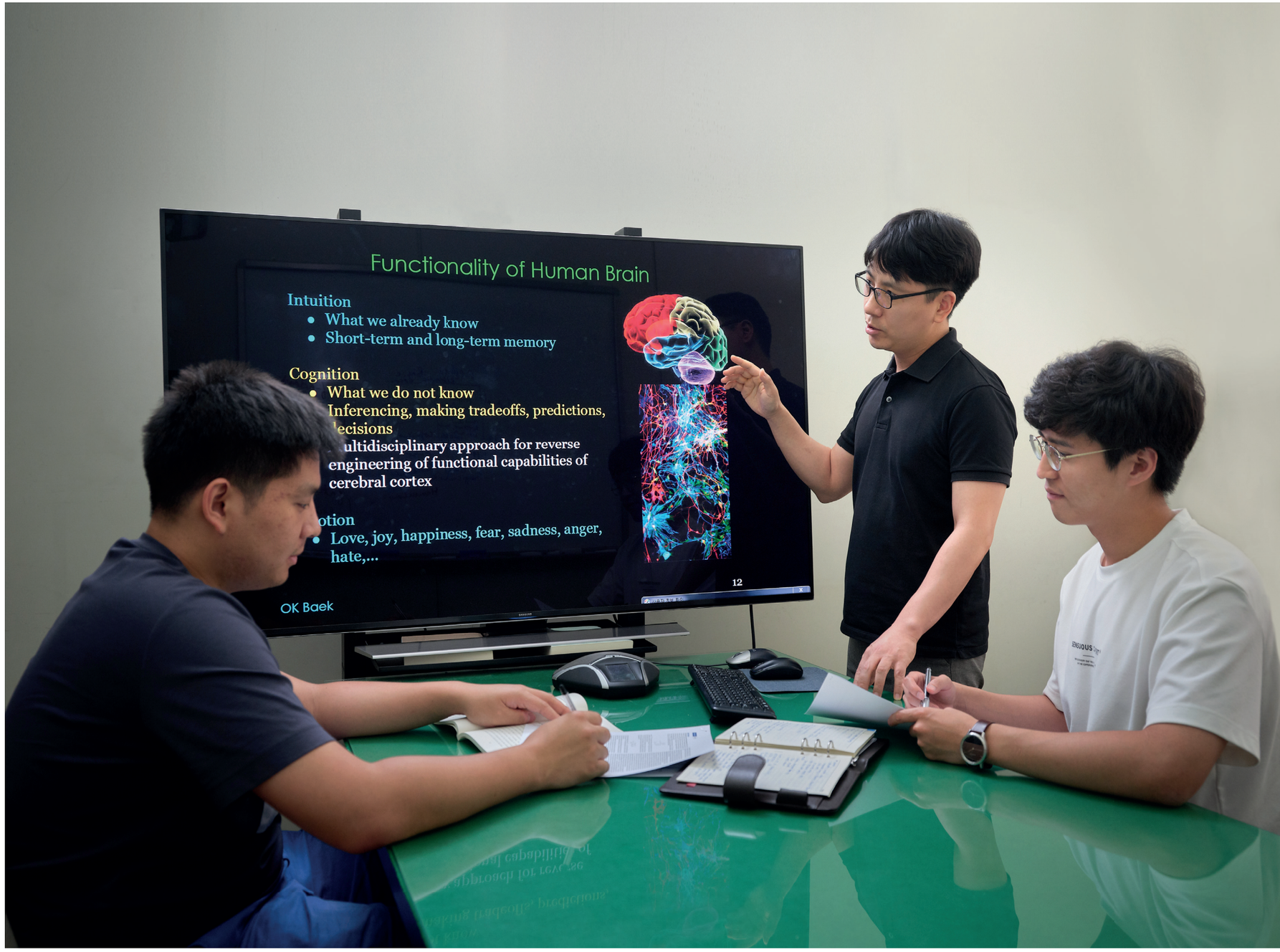
Part.1

THE MAIN R&D FIELD

ARTIFICIAL INTELLIGENCE RESEARCH LABORATORY

The Artificial Intelligence Research Laboratory is conducting key research and development with a view to playing a pivotal role in ETRI's vision of becoming a 'National AI Research Institute'. It has established the strategic goal of laying the foundations for a super intelligent information society in which humans and artificial intelligence coexist harmoniously, and of realizing super-performance computing that overcomes the performance limitations of artificial intelligence.

To achieve these goals, the Laboratory is developing key technologies such as complex AI, intelligent robots, autonomous unmanned vehicles, AI SoC, and AI supercomputers. It will pursue a hybrid R&D strategy encompassing core technology research and mission-based research, as well as enterprise support and the resolution of social problems. More than 450 researchers with masters and PhDs in the field of artificial intelligence and ICT are in charge of the core research and development, and are pursuing technological innovation through open R&D strategies, including joint research with universities and companies.



Intelligence Information Research Division

The Intelligent Information R&D Division aims to secure long-term Artificial Intelligence technologies that can see, listen and learn in ways similar to human beings. The research is focused on Language Intelligence, Voice Intelligence, Visual Intelligence, and Smart Data Analysis, all of which are core technologies that will inevitably lead the Fourth Industrial Revolution. Furthermore, it is probing original technologies such as Incremental Learning and Multiplex Intelligence to adapt to emerging next-generation advances in post-Deep Learning.

The plan is to acquire highly crucial Intelligence-Information technologies by adopting a select and concentrated strategy. The Division also wants to support the ecosystem of the domestic Intelligence-Information industries by supplying and disseminating the technologies it has secured through Open API platforms.

Future Computing Research Division

To fulfill the computing requirements of large-scale AI training and real-time inference, the Future Computing Research Division is focusing on the research and development of core computing technologies that overcome the limitations of existing computing environments and provide a whole new mechanism for data processing and management. Currently, the Division is largely focused on R&D in the following areas: development of a core technology for memory-centric computing; architectural design of quantum computers, OS and system SW for neuromorphic computing; modeling and simulation technology for digital twins and Cyber-Physical Systems; development of a common framework for multi-cloud services; development of a storage integration technology between on-premise storage and public cloud storage; development of a high-performance AI technology for embedded devices, and development of a hypervisor- based secure SW platform.

Artificial Intelligence SoC Research Division

The processors of artificial intelligence applications are tasked with processing heavy data and computation loads prescribed by deep, complex neural networks. Current departmental research includes the design, development and implementation of a computationally concise and power efficient AI Processor architecture called 'AB Processor' which is capable of reaching 40 TFLOPS, with the next generation aiming to achieve the petaFLOPS-grade. The Division's ongoing research projects are geared towards enhancing the intelligence capability of semi-conductors, and include the following developments: visual intelligence chip VIC, server multi-chip AI module, mobile LPDDR5 memory interface, ultra-low power intelligent edge processor, intelligent radar for drone and human life detection, implantable bio-signal processing, isotope-based semi-permanent battery, and ultra-small random number generator. The Division is also an active participant in the international standardization of the functional safety of semiconductors.

Intelligent Robotics Research Division

The Department develops core intelligent robotics technologies that can operate autonomously, safely, and intelligently by judging a given situation on their own in order to prepare for aging problem and decreasing of the labor force.

The Intelligent Robotics Research Division is composed of the Autonomous Driving Intelligence Research Section, the Human-Robot Interaction Research Section, the Intelligent Robot Research Section, the Intelligent Positioning and Navigation Research Section, and the Intelligent Robotics Ulsan Research Section.

The Autonomous Driving Intelligence Research Section, which is engaged in the field of smart cars, is currently researching and developing V2X connected perception, and is planning and controlling core software designed to improve driving intelligence through the collection of driving data and machine learning. It is also making efforts to develop standards in these fields.

The Human-Robot Interaction(HRI) Research Section is conducting R&D focused on user information(identity-location-activity etc.) recognition, object class · posture recognition, and social HRI technologies.

The Intelligent Robot Research Section concentrates on filed robot technologies such as robot task-intelligence under unstructured and uncertain environments, robot navigation guiding intelligence without prior knowledge of roads, and surveillance robot's abnormality detection based on multi-layered probabilistic modeling. It is also developing reasoning-based knowledge convergence for robotic services.

The Intelligent Positioning and Navigation Research Section is focusing on the development of a personalized intelligence technology and a navigation intelligence technology based on the profile(position · state · cognition · preference) information and spatio-temporal information of people and objects in autonomous intelligence spaces.

The Intelligent Robotics Ulsan Research Section aims to build the creative ICT convergence of an ETRI-regional SME(small and medium enterprises) cooperative research cluster through customized, field-oriented research and to enhance the technical capacity of the region.

Autonomous Unmanned Vehicle Research Department

The Autonomous Unmanned Vehicle Research Department is conducting R&D with the aim of securing global competitiveness through the development of Intelligent Unmanned Vehicle ICT technology, and is playing a leading role in creating the related ecosystem. Unmanned vehicles(UxVs) include unmanned aerial vehicles(UAV), unmanned ground vehicles(UGV), and unmanned surface/underwater vehicles(USV/UUV). The use of UAVs is spreading rapidly, and it is expected that will continue to expand in the future.

The main R&D fields include UAV communications technology, UAV traffic management technology for orderly navigation, UAV simulation technology for the efficient and safe development of advanced technologies, safety technologies aiming at zero accident operation, technologies for autonomous mission technology that minimizes human intervention, UAV applications such as drones for public safety, and counter-drone technology against illegal drones to protect the nation and the public from crime and terrorism.

Intelligent Digital Transformation + Research Department

The Intelligence Digital Transformation+(IDX+) Research Team aims to develop novel technologies for cognitive reasoning in artificial intelligence(AI) based on the veracity and validity of human- and machine-generated data, with the aim of augmenting the mental and physical capabilities.

The IDX+ Research Team is focused on the development of a novel self-adaptive cognitive AI model(CybreBrain) and its application to pre-symptomatic precision medicine(CybreDx), and the development of a holistic multi-domain simulator(CybreSim) for application to particulate matter analytics(CybreAir).

Its research areas include Human Enhancement & Assistive Technology and Blockchain Technology. The Human Enhancement & Assistive Technology Research Section is currently concentrating on the development of core technologies to assist or augment human abilities, with an understanding of human mental and physical conditions. The research team is also working on a multi-sensory ensemble technology for human sensory and perception, physical power enhancement with a soft suit and artificial muscles, affective computing for cognitive enhancement, and future user interfaces based on transparent and 'morphable' materials and devices. Meanwhile, the Blockchain Technology Research Section is executing three research projects in the field of blockchain technology, including a distributed and trusted data transaction platform that will secure personal data privacy and rights, distributed self-sovereign identity management, and blockchain networking latency research.

TELECOMMUNICATIONS & MEDIA RESEARCH LABORATORY

The Telecommunications & Media Research Laboratory conducts research in three major fields: communication, media and contents, and radio-satellite, including 5G and Post 5G(5G +, 6G) mobile communication, which is an essential infrastructure of national growth, as well as hyper-realistic virtual broadcasting/digital contents for realizing everyday digitalization, and radio-satellite fields that are invisible but essential to the hyper-connectivity era.

In the communication sector there are the Future Mobile Communication Research Division and the Network Research Division. The former develops social issue solving technology with 5G, 5G convergence technology for other industries, and original technology for Post 5G, whereas the latter is developing an information/knowledge-based networking technology and an ultra-high-speed, ultra-wide band, ultra-low delay optical network technology.

In the media/contents sector there are the Media Research Division and the Creative Content Research Division. The former develops a hyper-realistic service technology that breaks the boundaries between virtuality-reality and the next-generation broadcasting media original-standard technologies. Meanwhile, the Creative Content Research Division develops digital contents technology for realizing human-centered digital life and next-generation content original technology for digital arts/technology.

In the radio-satellite sector, there are the Radio & Satellite Research Division and the Meteorological Satellite Ground Segment Development Department. The Radio & Satellite Research Division supports Korea's telecommunications policy through research on frequency, propagation environment analysis, and satellite communication and brasting. The Meteorological Satellite Ground Segment Development Department is developing a ground system that consists of an ensemble of facilities responsible for the acquisition, processing, and distribution, which is essential to enhancing the performance of meteorological satellites.

In the future, the Telecommunications & Media Research Laboratory will become a「Global Technology Leader」with world-beating competitiveness in the fields of communication, media-contents, and radio-satellite.

Future Mobile Communication Research Division

The researchers aim to become a pioneer in the field of future mobile telecommunications in terms of technological leadership and standardization activities based on the development of fundamental and system technologies that can overcome the limitations of performance, space, and latency. Furthermore, the researchers are pursuing the globalization of these technologies through international cooperation with other organizations and universities in the EU, the UK, Japan, and other countries around the world.

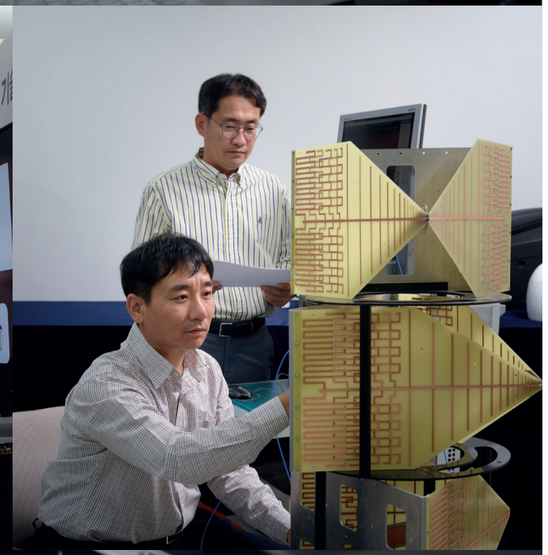
In parallel with the long-term development for breakthrough technologies, first-mover type, the reseachers are also developing user-centric practical technologies for commercialization as soon as possible, and conducting socially-oriented R&D to resolve the current problems facing public welfare.

The main areas of interest include such technologies as 6G wireless transmission and radio access, mobile networking between vehicles, cellular-based IOT, intelligent ultra-dense small-cells, distributed wireless communication, and high-capacity wireless back-haul.

Network Research Division

The Network Research Division conducts research and development on core and commercialization technologies for the network infrastructure as a key growth engine of the Fourth Industrial Revolution. The network infrastructure will support the realization and advancement of emerging services, including high-speed and broadband services, to cope with the ever increasing volume of data; hyper-connectivity services between humans and things; ultra-immersive services that offer interactive experiences beyond the limitations of people, time and space; and super-intelligence services that provide efficiency and convenience beyond human intelligence.

In order to lead the "intelligentization" of the nation, the Division is promoting R&D in the following six technology areas: ultra-high-speed optical networking technology; ultra-low latency networking technology; intelligent-based networking technology; data-centric networking technology; 5G and 6G mobile core networking technology; and ICT integration test technology.



Radio & Satellite Research Division

Radio resources have so far played an important role in the era of the Fourth Industrial Revolution, and the demand for them has been rapidly increasing. Furthermore, mobile communication services are changing from flat to solid as they are combined with satellite technology.

The Radio & Satellite Research Division has been developing technologies that enable the efficient use of radio resources, technologies for coping with the adverse effects of radio resources, radio base and fundamental technologies to create new services, RF and antenna components technologies, and satellite technologies that reflect contemporary trends.

To accomplish these goals, the Radio & Satellite Research Division consists of five sections, namely, the Radio Resources Research Section, the Radio Environment & Monitoring Research Section, the EM Wave Basic Technology Research Section, the Communication RF Research Section, and the Satellite Widearea Infra Research Section. Ultimately, the Division aims to transform Korea into a radio-satellite powerhouse.

Media Research Division

The Media Research Division is developing the world's best next-generation broadcasting/media core original-standard technologies, and an application service with the goal of realizing a hyper-realistic service that breaks the boundaries between virtuality and reality beyond the constraints of space and time.

The Division consists of the Media Broadcasting Research Section, Media Coding Research Section, Immersive Media Research Section, Media Intellectualization Research Section, and Digital Holography Research Section. The Division accomplished the world's best research and development achievements - including ATSC 3.0 technology, next-generation AV encoding technology, high-presence-feeling UWV technology, and digital signage technology - which have led Korea's broadcasting and media industry.

Currently, the major research fields are media transfer research, media encoding research, realistic media research, smart media intelligence research, and digital holography research. The ultimate goal is to create world-class hyper-realistic global broadcasting and media services and to lead the development of global broadcasting media.

Creative Content Research Division

The Creative Content Research Division aims to develop core technologies for digital-cultural content processing and to enhance global competitiveness in areas that will contribute to providing super-realistic services that maximize communication and experience. The researchers are focusing the efforts on the development of core technologies that can be applied to all industries, including education, defense, medicine, and manufacturing, as well as entertainment. The researchers are developing realistic image content technology, affective interaction technology, and intelligent content information retrieval technology in a bid to promote and lead the field in creative core technology.

As regards the development of realistic image content technology, the Division has been developing 3D content, 360º content, VR-AR content, plenoptic image content, holographic content, and a 3D character creation-authoring-editing-visualization technology. These technologies are now being applied in diverse industries, and continuous service expansion is expected.

In the development of affective interaction technology, the Division has focused on developing recognition-reproduction of the senses, neuro contents, home training, fine motion recognition, dementia management content, and realistic virtual training technology. It has also been trying to provide realistic and immersive digital environments to users by incorporating such technologies with virtual reality, augmented reality, and mixed reality.

As for the development of intelligent content information retrieval technology, the researchers have been striving to develop content analysis-understanding-retrieval, situation recognition, real-time human knowledge enhancement content, sports video-motion analysis, game AI, and copyright protection and distribution technologies in order to be able to provide more interesting and useful contents to users.

The Division is also supporting the product development, commercialization, and market development efforts of small and medium-size enterprises(SMEs) by dispatching expert research personnel from the Nuri Dream Square VR · AR Center in Sangam-dong to foster and support an environment conducive to the development of technical solutions.

The digital and cultural content technologies developed by the Creative Content Research Division are expected to serve as core technologies that will drive co-prosperity with other industries during the Fourth Industrial Revolution.

Meteorological Satellite Ground Segment Development Department

The Meteorological Satellite Ground Segment Development Group has been developing a ground system comprising an ensemble of facilities responsible for the acquisition, processing, distribution and archiving of next-generation geostationary meteorological satellite(GK-2A) data.

The GK-2A satellite was launched at the end of 2018 to carry out a meteorological mission and a space weather monitoring mission, replacing the nation's first geostationary multipurpose satellite(Communication, Ocean and Meteorological Satellite; COMS).

To support these goals, the Group plans to generate a synergy effect through collaboration with domestic and international groups by introducing state-of-art technology and cooperation development with electronics, IT, telecommunications, computer areas. This will be achieved by developing a core set of technologies, such as a control system, a product transmitter-receiver, a product pre-process and process analysis system, a space weather product process system, mission management, quality assurance, an image processing user custom service, a L1 · L2 algorithm experimental tool, and a broadcasting system.

The Group will continue striving to develop a new technology for a new ground segment of a polar-orbiting meteorological satellite mission.

INTELLIGENT CONVERGENCE RESEARCH LABORATORY

The Intelligent Convergence Research Laboratory is carrying out major research and development as part of efforts to promote ICT Convergence and Intellectual Informatization of the Nation and Society(city, traffic, welfare, environment, defense, safety, etc). It is researching and developing key technologies to come up with intelligent ICT solutions to the problems of people's lives with the establishment of direction and standardization of intelligent ICT policy. In particular, the laboratory is playing a leading role in improving the safety and quality of people's life by performing R&D aimed at realizing consumer-oriented new manufacturing and energy industry ecosystem, creating a smart city as well as intelligent transport · logistics ICT infrastructure, realizing next-generation medical intelligence for enabling 100 years of health, and accomplishing intelligence of the defense ICT and public industrial safety. It is also focusing on intelligent cyber-security core technologies that block sophisticated and automated hacking.

Technology Policy Research Division

The researchers of the Technology Policy Research Division are playing a role as the ICT policy Think-Tank that is leading ICT Convergence and Intellectual Informatization of the Nation and Society. For this, the Division is carrying out policy research to identify preemptively the issues of policy, ecosystem, and R&D for intelligent digital transformation. In particular, it is proposing the intelligence convergence policy and R&D direction to develop intelligent ICT solutions for the people's life problem-solving. In addition, the Division is offering ETRI's R&D direction and conducting research on feasibility analysis for planning a big project through collaborations with other divisions within ETRI. It is also conducting policy research for the development of the related ICT industry including telecommunication and participating in TF with the government and related organizations for policy formulation. The Division also plans to establish and operate an ICT policy platform to disclose the results of the major research and share them with external institutions.

Standards & Open Source Research Division

As a group specializing in ICT standardization, the Standards & Open Source Research Division carries out standardization on future core technologies and vertical-domain smart services to solve public and social challenging issues. The primary research work of the division includes standardization for information and communication technologies such as Artificial intelligence, Blockchain, Fintech, Cloud computing, Big data, IoT, Wearables, Autonomous vehicles, Future networks, 5G, B5G future mobile telecommunications, and Multimedia communications. The research also encompasses standardization for ICT convergence services of different industries such as manufacturing, environment, energy, transportation, agriculture, medical, and welfare.

In addition, the division develops standards for public services, including technical regulations for broadcasting and communication facilities, public safety, and disaster response. Moreover, the division is managing open source governance to counteract open source risks and to support effective open source-related R&D works. Other activities such as promoting international cooperation with the relevant organizations and cultivating global leader-class committer for open source software development are also part of the role and duty of the division.

Cyber Security Research Division

Global IT security trends have switched their focus from industrial issues to national security issues in terms of response to cyber-security threats and from competition for multi-functions and speed to compete for software intelligence in terms of security technology and system. In this regard, the Cyber Security Research Division focuses on various research activities in the field of cyber-security, seeking to acquire R&D capability to enhance industrial competitiveness and solve pending national and social issues to realize a crimeless, safe country. Currently, the Division is mainly performing R&D in the following areas: Cryptographic Engineering Research Section; Authentication Research Section; Human Identification & Object Recognition Research Section; Network & System Security Research Section; Mobile Security Research Section; ICT Convergence Security Research Section; and Vulnerability Analysis Research Section.

Smart ICT Convergence Research Department

The Smart ICT Convergence Research Department is developing ICT technology for industry intellectualization and next-generation IoT technology in the era of the 4th industrial revolution.

The main research technologies in industry intellectualization include: ICT convergence-based technologies of flexible & reconfigurable production in the plant; open manufacturing service platform connecting the plant; future factory technology producing personalized products without human intervention; and VLC(Visible Light Communication) technology in various industry applications for the preemptive response to the manufacturing paradigm shift.

The main research technologies in next-generation IoT technology include: intelligent edge IoT; autonomous IoT; digital intelligence twin; common convergence IoT technology; development of device IDE(Integrated Development Environment) based on the microservices framework; and highly reliable · real-time · multi-hop IoT network technology in a poor radio wave environment.

The Smart ICT Convergence Research Department aims to be a global leader in the future industries and IoT intelligence technology.

City & Transportation ICT Research Department

City & Transportation ICT Research Department is consists of 3 research sections: the City & Geospatial ICT research section; the Cognition & Transportation ICT research section; and the Postal & Logistics ICT research section.

The City & Geospatial ICT Research Section is conducting research on Intelligent Convergence Technologies that enables smart intelligent city and smart space.

The Research Section has been carrying out research and development on 5G-based smart city service platform technology to improve city competitiveness as well as the quality of life of urban people. The Section is also researching and developing the next-generation spatial information fusion and core technologies that will lead the 4th Industrial Revolution and realize the intelligence information society of the city and traffic area. Especially, the researchers are realizing the Digital Twin City, which is an urban-scale virtualized reality, through next-generation spatial information ABC+D technology(geo-AI, geo-BigData, geo-Cloud, geo-CPS).

The mission of the Cognition & Transportation ICT research section is to identify societal issues on current and future transportation areas and to provide solutions via mental model-based human factor in-depth research and UI · UX-based ICT development. The main research areas are: (1) transportation information collection · analysis · visualization; (2) DVE(Driver, Vehicle, and Environment) monitoring; (3) assistance to the transportation-vulnerable; (4) human factor in-depth research and human transportation interaction; (5) identification of future transportation problems and provision of solution technologies; and (6) decision-making algorithm based on the mental model.

The Postal & Logistics ICT Research Section conducts dedicated to research on the following: (1) development of mail acceptance, sorting, and delivery core technology and postal field application; and (2) construction of drone delivery infrastructure, development of intelligent control technology for drone delivery, and field demonstration, aiming at ensuring the efficiency of national logistics and infrastructure based on logistics innovation.

Welfare & Medical ICT Research Department

Given the social problems such as entry into aging society and surge in medical expenses, peoples are faced with a paradigm shift in maintaining a healthy life-from diagnosis and treatment to disease prevention and management; hence the increasing need for technology development through the convergence of ICT and biomedical technology to reduce medical costs and improve medical welfare.

The Welfare and Medical ICT Research Department applied ICT technology to biotechnology and medical services to meet these social needs. As a result, the Research Department aims for healthy 100 years of living by developing medical intelligence solutions.

The main R&D technologies include: Automated field diagnostic technology to obtain high-quality bio information quickly on-site; Dr. Artificial Intelligence technology that predicts the future state of patients by cooperation of medical intelligence; Small · low-cost particle beam generation core technology for the precise target treatment of cancer; and Intelligent Medical image analyzing technology.

Energy & Environment ICT Research Department

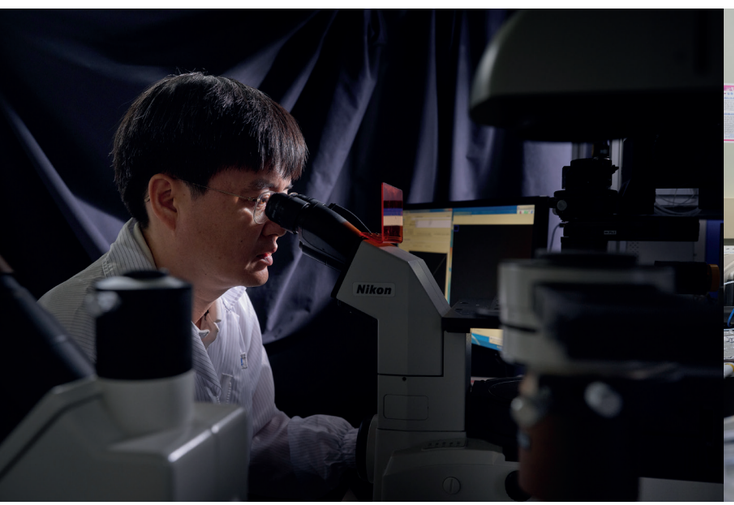
The Energy & Environment ICT Research Department aims to develop technologies coping with national energy and environmental problems due to global climate change. To realize energy intelligence, the Department develops the following technologies: energy cloud technology; reliability · stability assurance technology for renewable energies; block chain technology for energy trading; artificial intelligence-based energy prediction and optimal control technology; big data-based energy data analysis; intelligent service platform technology; and energy management of factory and apartment complex for efficient energy utilization.

In additions, to cope with environmental problems due to rapid climate change, the Department develops the following technologies: unmanned mobile sensor-based algae monitoring & management for clean water environments; and unmanned mobile access detection for water facility protection.

Defence & Safety ICT Research Department

Guided by the motto of developing ICT-based intelligent solutions to address problems of national life in the public sector, the members of the Defense & Safety ICT Research Department have concentrated on developing the following: national defense hyper-connected trust infrastructure; national defense hyper-intelligent decision-making & autonomous control; national defense hyper-realistic military drill platform; safety management life cycle intelligent solutions; and disaster management life cycle intelligent solutions.

The main R&D technologies for national defense ICT include: hyper-connected trust infrastructure technology; mission-oriented collaborative control technology; hyper-intelligent decision-making technology; autonomous & intelligent networking management control technology; and hyper-realistic military drill platform technology, On the other hand, the main R&D technologies for public safety ICT include: ICT-based public safety life cycle intelligent management technology; intelligent disaster spread prediction & response & resilience technology; context-aware public safety service technology; crime danger prediction & prevention technology; ICT-based industrial and private danger prediction & prevention technology; public safety management service device & application technology development; and safety information sharing & distribution standard technology development.



ICT CREATIVE RESEARCH LABORATORY

The ICT Creative Research Laboratory has the vision and goal of 'leading the future ICT technology through disruptive creative research,' and it is carrying out challenging research and development of new future ICT technologies in order to contribute to the realization of the 4th industrial revolution and Beyond-5G hyper-connection society.

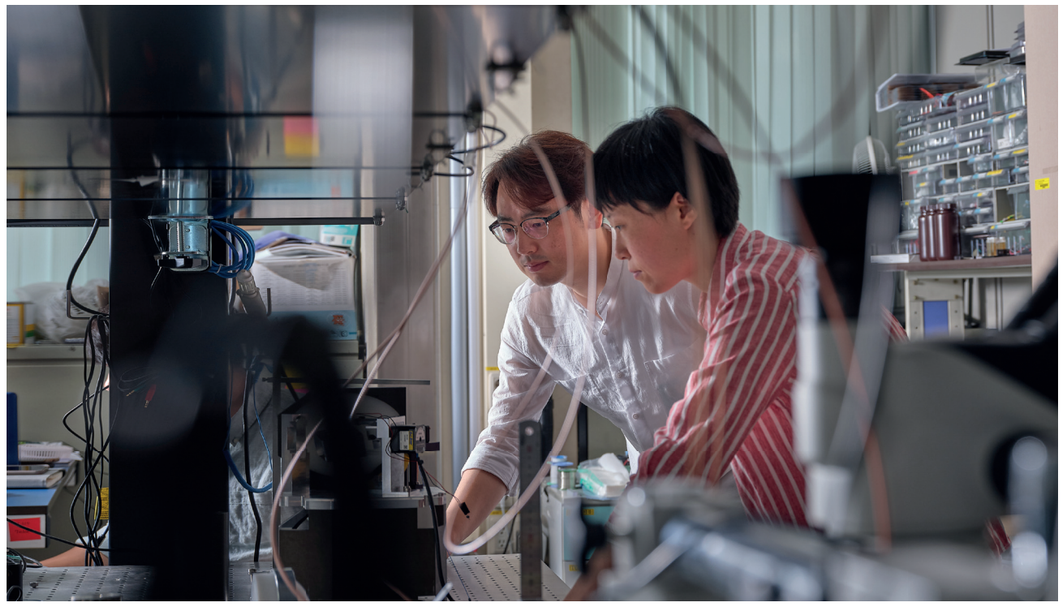
To achieve such vision and goal, the ICT Creative Research Laboratory is researching and developing cutting-edge future technologies such as human enhancement devices, cloud intelligence enhancement devices, neuromorphic devices, quantum computing SW · HW, quantum communication, tera-bps photonic · RF convergence components, wearable super-sensory communication, holographic space interaction devices, ultra-light AR · VR devices, etc. In addition, the ICT Creative Research Laboratory is exploring and researching more basic underlying technologies such as terahertz devices, synapse-based emotion cognition devices, nano-electron source, 2D · nano semiconductors, meta materials, quantum devices, etc.

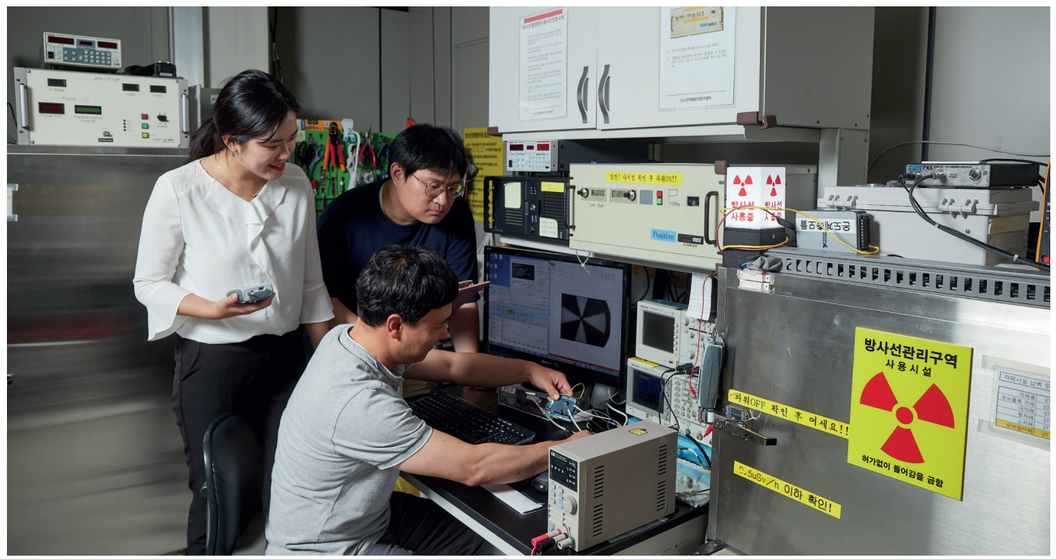
By creating synergy from the collaboration with industries and research institutes in Korea and abroad, the ICT Creative Research Laboratory will also do its best to help domestic component companies take the lead in new markets and become global enterprises, making Korea a strong nation in the field of ICT devices and semiconductors.

Future & Basic Technology Research Division

The Future and Basic Technology Research Division is seeking to discover new future technologies in terms of 'disruptive' and 'original' technology in the direction of 'realizing future technology growth by revitalizing creative challenge research.' 'Disruptive' technology emphasizes the destruction of tradition, industry reorganization, and profit maximization, whereas 'original' technology aims at the world's first and most unique technologies. For this purpose, the Division will pursue creative research in all fields of ICT for information generation, sensing, processing, storage, and transmission.

The Future and Basic Technology Research Division is aiming at various directions of creative research such as brain wave communication, mental model, breakthrough of transmission limit, breakthrough of communication method, guarantee of AI reliability, etc. The Division is committed to the development of hyper-intelligence technologies(trusted reality based see-thru communcation), hyper-connectivity technologies(hyper-trust worthy see-thru communcation), hyper-sensitivity technologies(advanced wearable communication), and creative challenging technologies(brain based informatiojn technologies, basic & creative technologies for ICT) as the leader of the future ICT creative technology. In addition, research on the photonics- and RF-electronics-based THz core technologies ranging from THz generation · detection devices to THz application systems have been performed. The Division is currently working on novel THz technologies such as wavefront shaping, THz 3D imaging, non-destructive inspection, security screening, and wireless communications to be at the forefront of THz technologies.





Materials & Components Research Division

The Materials & Components Research Division will contribute to realizing the future hyper-connected society as a global leader by creatively merging smart devices such as super-fast communication devices, super-real display devices, and highly efficient sensor devices, which are achievable from the basic and applied technology of materials and components.

In order to lead the next-generation ICT technology in new materials and components, the Division will build a circulatory growing system in order of basic new materials – parts & components - system industrialization in the relevant area in advance. To realize all the above in a concrete way, the Division also vitalize the synergy of project planning, project area diversification, and convergence information sharing with the organization of global cooperative research groups.

The work of the Division belongs to ETRI's classification of technology domains. Research studies are mainly focused on the areas of materials and components, specifically functional materials, energy · packaging · neuromorphic materials, nano-electron source, metal-insulator-transition devices, nano-based emerging devices, and semiconductor convergent devices · components, etc. The Division also seeks to maximize the synergy effect from open and cooperative research studies between those areas.

Reality Devices Research Division

As the information society becomes more sophisticated and diversified, there is a growing demand for devices that can read and output more realistic information in the exchange of information between humans and humans, humans and objects, and objects and objects. Reality devices are capable of inputting · outputting human sense of vision, hearing, tactile sense, etc. Such devices can be incorporated into various forms of display, microphone · speaker, and electronic skin.

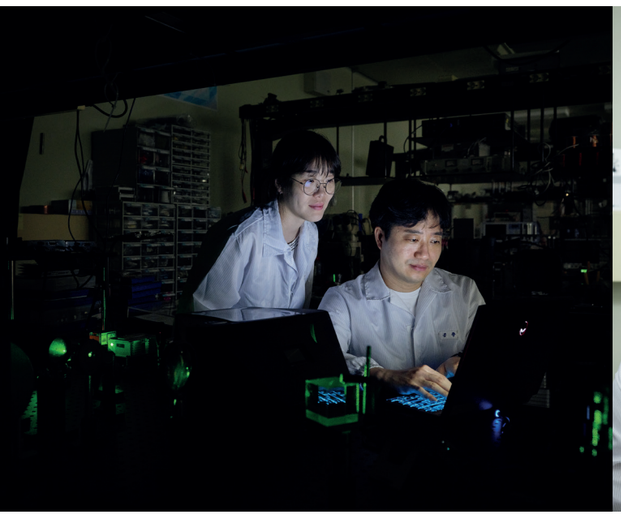
At the Reality Devices Research Division, the researchers focus on developing next-generation displays, multi-functional sensors, realistic image panel, and skin electronic devices. Stretchable displays, MEMS sensor devices and modules, digital holography optical modulator, OLED microdisplay, and sensory input · output panels are also being investigated as core technologies. The Division utilize its technology infrastructure to develop prototypes for material · part · equipment companies in related fields and provide them with technical support in resolving their technology hurdles.

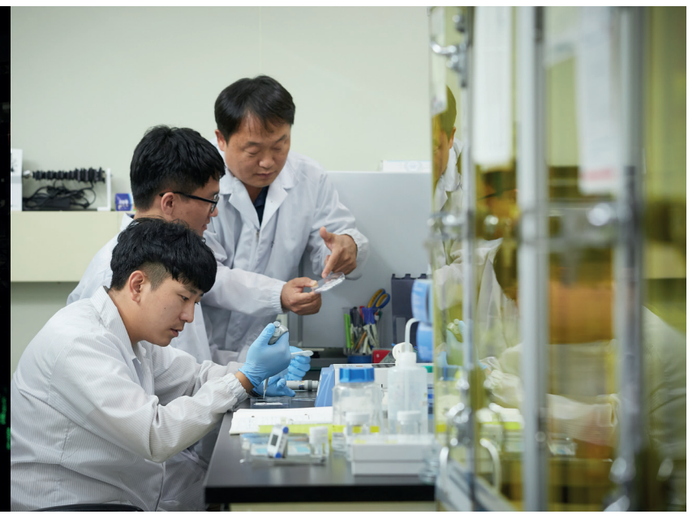
The Reality Devices Research Division will contribute to the enhancement of national technology and industrial competitiveness by developing the technology of materials and components for reality devices for the improvement of the quality of life.

Photonic & Wireless Devices Research Division

For the purpose of a hyper-connected society, the use of compound semiconductor-based electronic and optical devices to facilitate an ultra-high-frequency broadband convergence network is inevitable.

The Division focuses on several R&D areas. Compound semiconductors such as InP, GaAs, SiGe, and GaN are used to develop the MMIC and its transceiver module with cost-effectiveness, small size, light weight, and low power consumption for millimeter-wave wireless communication systems. In addition, the researchers are engaged in vigorous R&D on advanced photonics and RF-photonic technologies that bring about new innovations and new possibilities for tera-bit optical communications based on photonic integrated circuits and millimeter-wave MMICs. The Division is also currently working on a project to predict green algal tides by making use of several ICT technologies to solve environmental problems.





Quantum Technology Research Department

New forms of data collection, transmission, and processing for very big data, artificial intelligence, trust communication, super high-performance computing, and ultra-sensitive sensing will play key roles in determining national competitiveness. Quantum technologies that directly use physical quantum properties such as superposition, entanglement, and interaction with the environment in processing information are developed into next-generation technologies providing faster, safer, and more precise ICT after the 4th Industrial Revolution.

The research areas are quantum communications, quantum sensing, and quantum computers. Quantum communications will be wired, wireless, satellite quantum communications that will eventually be extended to quantum Internet. Quantum sensing will help detect cancer by using quantum MRI, replace GPS with super-precision quantum navigation, and enable seeing the invisible side with quantum imaging sensor. The quantum computer will speed up the super artificial intelligence with transcendental computational capability that goes beyond the current computers.

KSB CONVERGENCE RESEARCH DEPARTMENT

*KSB(Knowlege-converged Super Brain)

The KSB Convergence Research Department is actively conducting research aimed at securing technology for implementing a human-centered, hyper-connected intelligence information society to cope with the coming Internet of Everything(IoE) era. Specifically, the Department is focusing on research and development of the core Self-learning knowledge-converged superbrain technologies that refine the multimodal data collected through the IoE network, extraction of knowledge through machine learning, and subsequent provision of forecasting, prevention, and optimization intelligence services.

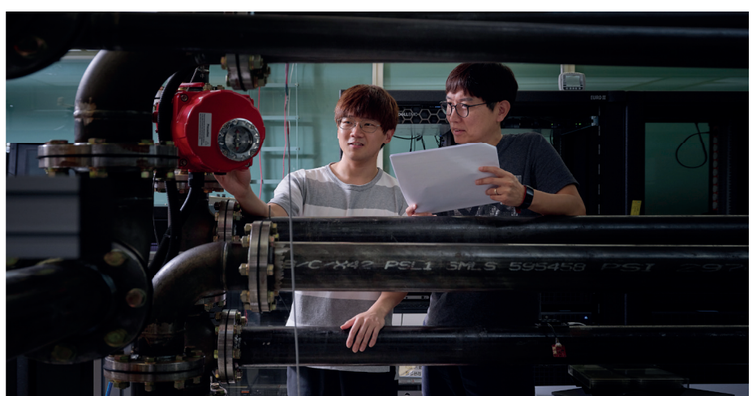
Consisting of four government-funded research institutes -- Electronics and Telecommunications Research Institute(ETRI), Korea Institute of Energy Research (KIER), Korea Atomic Energy Research Institute(KAERI), and Korea Research Institute of Standards and Science(KRISS) -- the KSB Convergence Research Department is implementing a Future-leading-type Convergence Research Project for solving pending national and social issues experienced by citizens as well as large-scale technical issues in the industry, funded by the National Research Council of Science & Technology.

In order to achieve the three core values of High-quality connectivity, Information intelligence, and Service diversification, the KSB Convergence Research Department has developed the following: self-learning knowledge-converged artificial intelligent platform; hyper-connected IoE edge computing and standardization; and domain knowledge-converged intelligence services(energy efficiency, plant safety, health for the elderly, etc.). In addition, it realizes a human-centered, hyper-connected intelligence information society converging the Internet of Things(IoT), Big Data, Artificial Intelligence(AI), and domain knowledge and plays the role of leading the fourth industrial revolution technology.

KSB Convergence System Research Section

KSB Convergence System Research Section is performing the KSB Convergence Research Department's tasks, establishing strategies for utilization and deploy, and performing system engineering roles, including R&D process and quality control, including defining system requirements. In addition, we have developed domain-specific machine learning/deep learning models and application services for energy and health areas with the goal of providing domain knowledge convergence intelligence services for solving national and social issues and presenting effectiveness.

Major R&D technologies include the Autonomous distributed building management system technology to analyze the patterns of occupant and energy consumption by area through machine learning/deep learning, to autonomously optimize the occupant environment of heating and lighting, etc., and to predict the energy management and demand according to the situation in each area, and also the IoE based health(stroke) monitoring system technology for elderly to enable them to detect stroke risk and emergency situations in advance and respond quickly through machine learning/deep learning and medical knowledge-base, based on monitoring vital signal with wearable devices during their daily lives, such as walking, driving and sleeping. In addition we are researching the IoE intelligent context aware and collaboration technology to minimize human intervention by recognizing and cooperating with the surrounding situation.



KSB Artificial Intelligence Platform Research Section

The KSB Artificial Intelligence Platform Research Section aims to research and develop infrastructure technology for AI services in various domains. To achieve the goal, we are performing research on AI service infrastructure framework, platform technology to operate in various environments, and KSB-based AI ecosystem and governance technology to interconnect different platforms.

In particular, we are working on the KSB AI framework technology that combines IoT, big data, machine learning, and serving infrastructure, the KSB Edge and KSB Core/Cloud platform technology based on KSB AI framework that can be deployed in various environments, and the KSB-based hierarchical(Edge-Core-Cloud) AI ecosystem and governance technology.

KSB Artificial Intelligence Application Research Section

The KSB Artificial Intelligence Application Research Section is performing of development for KSB Artificial Intelligence technology in terms of applied to IoE edge devices and solution development in various domains, and establishing of KSB-based AI testbed and global standardization for AI-based technology diffusion.

R&D technologies mainly involve development of solutions such as lightweight-based AI solution and advanced mechanical safety using anomaly detection solution, with lots of partner companies. The team is practically verifying research outputs developed by The KSB Convergence Research Department, and establishing a real testbed to validate the developed solutions for AI ecosystem creation and spread. The team is also researching of AI-based data intelligence to improve high quality data integration over the KSB-based AI testbed, and global standardization for AI-based technology diffusion.

KSB Device Machine Learning Research Section

The KSB Device Machine learning Research Section is performing R&D with the aim of developing and standardization of technologies that enable machine learning-based inference on the resource constrained devices such as light-weight devices, mobile devices, industrial gateways, resulting in applying to industrial domains.

Major R&D technologies include the IoE specialized Machine learning(ML)/Deep learning(DL) algorithm technology, the light-weight machine learning technology that can be mounted on the resource constrained devices, and the light-weight Machine learning/Deep learning standardization technologies. It also includes the development of the leak detection sensor in the plant domain and technologies for AI-based leak detection services such as data gathering, preprocessing, and Machine learning/Deep learning modeling.

SDF CONVERGENCE RESEARCH DEPARTMENT

*SDF(Smart Defense for FMD)
FMD(Foot and Mouth Disease)

The SDF Convergence Research Department is carrying out a project to develop an intelligent FMD(foot-and-mouth disease) countermeasure system that incorporates ICT intelligence information technology as part of the project of the National Institute of Scientific and Technical Research. The targeted FMD response system consists of step-by-step, intelligent core values such as early detection of livestock disease, on-site diagnosis, prevention of premature ejaculation, and prevention of spread. For the practical application of the FMD response system, the Department is working on the development of a practical core response technology through continuous collaboration with FMD experts.

The focus of the SDF Convergence Research Department is the early detection of anomalies using AI(biomedical, visual, voice, etc.), highly sensitive molecular · immune diagnostic system and automatic data transmission system, automatic alarm for emergency prevention and app-based disinfection of livestock vehicles, AR · VR education system (vaccination, prevention, etc.), and domestic risk of foreign FMD. The SDF Convergence Research Department will contribute to the preemptive response to FMD, which is a national disaster, through the development of technologies for comprehensive FMD response.

Intelligent System Research Section

The research team is developing a core platform for smart farms and preventing and managing the growing number of livestock diseases worldwide. Moreover, the research team is responsible for the development of service platforms by the SDF Convergence Research Group and system architectures and core technologies such as service requirements analysis, integrated test planning, and test bed and test environment. Companies and organizations related to agricultural and livestock industries are supported through the diffusion of data-driven intelligent platforms combined with intelligent information technologies such as IoT, AI, Cloud Computing, and Big Data technologies. Through these efforts, the Intelligent System Research Section will contribute to the development of an intelligent information ecosystem in the areas of agricultural and livestock industries for the resolution of national and social pending issues and creation of new industries.

Disease Symptom Research Section

The main goal of the research team is the 'Development of a risk assessment system for domestic FMD taking into account the outbreak situation of an overseas disease' and the 'Development of early detection technology for abnormal symptoms through real-time monitoring of livestock behavior and biological information.' To construct a risk assessment system for domestic FMD, the Section plans to establish an early warning system for the risk of domestic FMD through the database of OIE(Office International des Epizooties) reports and news from neighboring countries. To develop early detection technology, the research team plans to obtain data on the physical anomalies of livestock including diseases by monitoring the daily state of livestock based on the daily activities of livestock, feeding and drinking water, sound, and temperature. The early detection system will report the abnormality by passing the collected data to farmers, veterinarians and animal hygiene laboratories to identify infections.

Diagnosis Platform Research Section

The main goal of the research team is the 'Development of a FMD diagnosis platform that can quickly diagnose FMD virus and transmit the result to FMD security system automatically'. FMD is a livestock disease causing national disaster, thus, in case of virus infection, rapid early-stage confrontation and diagnostic accuracy(high sensitivity) are required. For the high-sensitive point-of-care FMD diagnosis, the research team is developing related core technologies including high-sensitive diagnostic antibody, nano-materials based immune diagnostic kit and rapid gene amplification, portable instrument for immune/molecular detection, and automated data collecting EIEC(Easy-Input-Easy-Connect) system. Using these technologies, the team will finally construct a diagnostic platform for FMD field diagnosis and enhances the early-stage response capability on FMD.

DAEGU-GYEONGBUK RESEARCH CENTER

The Daegu-Gyeongbuk Research Center was established in 2006 to enhance technical capacity and to serve as an R&D Hub of Daegu Metropolitan City and Gyeongbuk Province. It aims to accelerate the technological convergence of the Smart City, Smart Vehicle, Smart Medical and Smart Agriculture ICT fields and to support technology commercialization.In addition, the Daegu-Gyeongbuk Research Center supports the growth of regional small and medium-sized enterprises(SMEs) by supporting technologies customized according to SMEs' demands, assisting them with overcoming technical difficulties, and providing technical advice and technology commercialization activities, with the ultimate aim of spreading ETRI-owned technologies.

The Daegu-Gyeongbuk Research Center is leaping forward as an intelligent research institute dedicated to creating a better tomorrow for the Gyeongbuk region.

- **Main Research Fields**

· **Smart City :** Research on Smart Traffic-Safety System Technology
· **Smart Medical :** Research on Medical ICT Convergence Technology
· **Smart Mobility :** Intelligent Robot Technology / Smart Radar Technology
· **Smart Agriculture :** Research on Smart Farm Technology

Regional Industry IT Convergence Research Section

The Regional Industry IT Convergence Research Section(RITC) conducts R&D with the aim of contributing to strengthening ICT convergence technology and revitalizing local industries by integrating ETRI's ICT technology with strategic and traditional industries in Daegu Metropolitan City and Gyeongbuk Province.
In order to strengthen the technological competitiveness of small and mid-sized companies in the Daegu and Gyeongbuk region, the Section is striving to find on demand technology and to analyze the related technical performance of IT convergence technologies required by the industry, and ICT-related technical guidance, advice and support for technical difficulties.

As regards smart farm technology, the RITC is developing practical, field-specific smart farm technologies, including an intelligent weighting water irrigation technology, a customized greenhouse smart farm solution technology, and a reliability guarantee technology in an effort to maximize production. In order to lead the agriculture industry of the future, it is currently focused on the introduction of a big data-based smart farm technology at domestic and oversea farms.
The RITC also carries out quality management of the technologies developed at the Daegu-Gyeongbuk Research Center and is running the fourth human resource training program.

Artificial Intelligence Applications Research Section

The researchers are devoted to research areas that use machine learning(ML) and deep learning(DL) to develop AI features for applications in a number of domains. The most notable technologies include an automatic traffic control technology for the traffic domain, an outlier detection module for the security domain, and platform and database management for the automatic productions domain. The Section is committed to finding ways of alleviating ongoing social demands by contributing AI solutions, and also aims to support small and medium-sized enterprises(SME) by providing accessible technical solutions for technologies that are in great demand.

Smart Mobility Research Section

The Smart Mobility Research Section is dedicated to developing core technologies required in related research fields and industries, as well to enhancing the technological competitiveness of local businesses. The R&D strategy basically originated from the expansion of new technologies in the smart mobility field via AI-based signal processing and recognition technology.

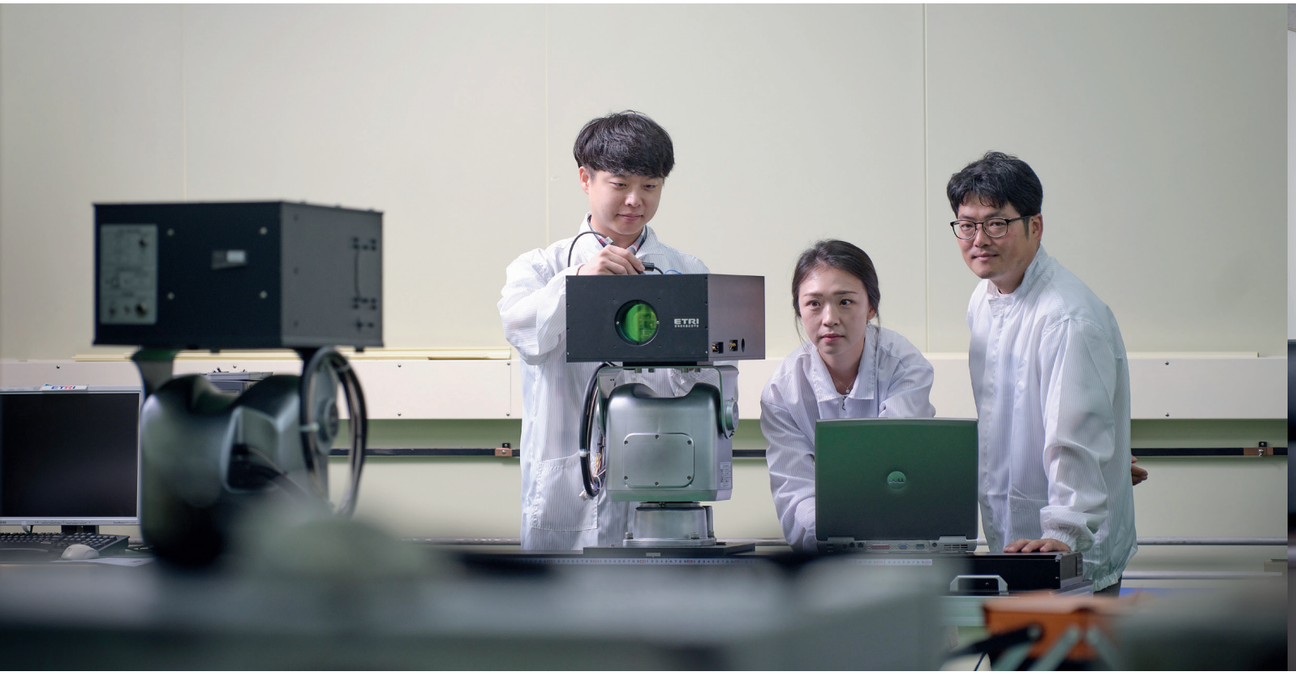
The main R&D technologies are as follows: an object recognition radar technology for smart cars, a multipurpose intelligent radar technology for ITS(Intelligent Transport Systems), an autonomous driving platform technology based on sensor fusion, a smart agricultural machinery technology based on intelligent control, a multiple AGV control technology for logistics management, a vehicle attitude control and tracking technology, and a human interactive cooperative robot technology.

Medical IT Convergence Research Section

The Medical IT Convergence Section is promoting the development of a new medical industry by developing medical ICT fusion technologies based on Daegu and Gyeongbuk provinces, and aims to strengthen the technological competitiveness of SMEs through open R&BD.

The Section has discovered various medical ICT convergence technologies centered on end-users(hospitals and companies), and is developing key technologies for smart medical devices that reflect local needs through joint research with companies.

In addition, the Section continue to support the necessary electrical and mechanical stability tests, animal tests, and commercialization of products required to obtain approval for medical devices.



HONAM RESEARCH CENTER

The Honam Research Center(HRC) serves as a technological hub to foster regional strategic industries through R&BD on ICT convergence technology within the Honam area. To date, the HRC has been supporting the development of leading technologies based on the region's strategic industries, the development of customized technologies to nurture local companies, and the commercialization of the technologies developed by ETRI. In addition, the HRC provides A2LA test certification service for optical communication components, equipment and pilot-production support for optical packaging technologies, and a variety of technical support systems to resolve technical difficulties.

Optical ICT Convergence Research Section

Optical convergence system technology is one of the core technologies for the fourth industrial revolution. As such, the Optical ICT Convergence Research Section is conducting R&D in the field of optical imaging, optical wireless, and optical sensor in order to enhance the global competitiveness of Korean optical industry. In the optical imaging field, the researchers are studying disease diagnosis technology and holography technology by adopting AI-based hyter-spectral imaging analysis. In the optical wireless field, the researchers are studying broadband long range FSO technology that could be used in unmanned aerial vehicles. In the field of optical sensors, various optical sensors used for electric power facilities are currently under research and development.

ICT Convergence Strategy Research Section

The ICT Convergence Strategy Research Section supports regional innovation growth related with the regional strategic industry, such as optical communication, automobile, energy, healthcare, culture contents. Through the search, utilization and proposal of specialized technologies in order to improve business growth and social issues in the Honam region. To this end, the Section is responsible for such tasks as business planning and requirements discovery, support and collaboration on the settlement of strategies and policies, performance of technology exchanges and applications and so on, using the main core technologies of the Fourth Industrial Revolution, such as DNA(Data, Network, and Artificial Intelligence) and AICBM(Artificial Intelligence, IoT, Cloud, Big-data, Mobile).

Edge Computing Application Service Research Section

The Edge Computing Application Service Research Section is researching and developing real-time edge computing technology for the advancement and intelligentization of the domestic strategic industries such as the energy, smart city, and automobile sectors. To this end, the Section is researching and developing core technologies for real-time networking, such as a precision time synchronization technology and a time-aware scheduling technology, and researching and developing an intelligent edge gateway platform technology that can collect, analyze, and process data locally while accommodating various industrial communication protocols.

As regards the practical application of the developed core technologies, the researchers are researching and developing a real-time communication platform that is applicable for high and medium voltage DC transmission and a distribution power converter, an energy management solution for factories and buildings based on edge computing, and edge computing-based smart city service solutions along with the related industries. In this way, the Section is promoting technology commercialization by securing the technologies that can be used in the actual field.

Energy Intelligence Research Section

The Energy Intelligent Research Section conducts research aimed at creating an intelligent energy system by applying ICT technology to complex energy systems that combine diverse electric, heat, gas, hydrogen and renewable energy sources. To achieve this, the researchers are developing energy generation-storage-consumption mixed prediction, energy system failure prognosis, sensor module remote management, big-data analytics, and an energy system autonomous operation technologies. The Section is also working in the energy system fields with an energy-IoT and artificial intelligence technology. Furthermore, the researchers are studying an energy big-data technology to create new business models. In cooperation with KEPCO, we have completed the standardization of energy-IoT and are establishing the TTA and KS standards. The Section is also expanding out standardization activities in the energy sector, such as home demand-response inter-operation.

Optical Packaging Research Section

The Optical Packaging Research Section(OPRS) aims to enhance the global competitiveness of local strategic industries by supporting R&D and the commercialization of optical components and modules. The core R&D areas are high-speed optical components for 5G and data center networks, which are driving the rapid growth of the optical component market. Recently, the OPAC(Optical Packaging Assist Center), which is the key infrastructure of the OPRS, stared supplying a new technology service to industries with the aim of bridging the gap between R&D results and commercialization by supporting the entire range of processes from prototyping to pilot production in a tightly coupled manner, thereby encouraging small and medium size companies to address the global market in time.

SEOUL SW-SoC CONVERGENCE R&BD CENTER

The SoC(System-on-a-Chip) is an electronic component that combines HW & SW and implements the functions of the system on a single chip. It is being applied in many areas, including automobile, bio, smartphone, and DTV. This is a pivotal field for discovering new convergence systems, and is drawing attention as a new national growth engine. Seoul SW-SoC Convergence R&BD Center(Center) runs a specialized human resources training program based on industrial demand for highly qualified SoC design personnel armed with IT convergence expertise, and supports small semiconductor fab-less businesses in Korea.

Recently, as a forward base for ETRI's development of an artificial intelligence(AI) technology in the Seoul Metropolitan Region, it has developed a shared platform for an AI technology required by small and medium-sized enterprises. The Center is also actively engaged in publicizing and spreading technologies held by ETRI in the related fields.

Artificial Intelligence Convergence Research Section

The Center is actively responding to the promotion of ETRI's research performance and solving community problems by energizing the development of AI and by serving as a bridgehead to work on convergence technologies in collaboration with local industries, academia and institutes for the community. Notably, it will take the lead in cultivating the industry ecosystem of AI by providing an AI SW opened API platform service from ETRI research community and building machine learning data which can be shared with various AI projects of small businesses including startups.

SW-SoC Development Environment Research Section

In order to support SoC fab-less, the Center is responsible for establishing the industrial SoC infrastructure to support fab-less. By building the expensive SoC infrastructure and helping companies to use it jointly, the researchers are striving to strengthen the competitive power of Korea's SoC industry and expand its technological base. The Center also supports an environment for joint IP use and verification to shorten the development period and minimize the development risks.

Regional ICT Convergence Research Section

Based on demand from regional industries, the Center is developing various ICT convergence technologies, such as an AI accelerator design tool using the SoC virtual platform and a knowledge-based smart factory AI framework for data analysis, for use by manufacturing companies, which will promote ICT and AI technologies to local industries.

SW-SoC Human Resource Development Section

Intelligent Semiconductor Expert Human Resource Development is developing SoC master's and doctoral high-level design human resources. It contributes to resolving the shortage of design experts among small and mid-sized enterprises by promoting employment with them, and is also helping to resolve the qualitative mismatch between university education and industrial needs. In addition to SoC design practice training based on the needs of companies, various training courses related to the Fourth Industrial Revolution(AI, Big Data, Block Chain, Cloud, IoT etc.) are consistently planned and implemented, such as ETRI employee training, corporate on-demand training, employment-linked training, and practical employee competency improvement training among others. Furthermore, to expand the research outcomes of ETRI's research department, education courses have been launched in collaboration with the research department.

SMEs AND COMMERCIALIZATION DIVISION

As a trusted partner with industries, the SMEs and Commercialization Division aims to support the innovative growth and technological competitiveness of the ICT industries. To achieve this goal, the Division is promoting the utilization and diffusion of ETRI's R&D results and establishing a system for supporting the technology commercialization of SMEs. Currently, the Division mainly focuses on research into technology commercialization and SME support strategies, the operation of technology commercialization support programs, the creation and utilization of intellectual properties(IP), and support for SMEs and technology-based startups. The Division also provides the ETRI Technology Commercialization Platform(TechBiz) as an integrated and comprehensive platform on which SMEs can utilize the various commercialization support programs they need.

SMEs Innovation Center

The SME Innovation Center supports ICT SMEs' efforts to grow into leading global companies and play a leading role in national economic development. To this end, the Center promotes the successful commercialization of SMEs' technologies by making use of ETRI's research personnel, testing facilities, equipment and research infrastructure.

First of all, the Center operates a program by which ETRI researchers are dispatched to provide direct on-site support to SMEs that experience difficulties in securing advanced researchers.

The Center has also set up a Research Equipment Sharing Center so that SMEs can use ETRI's advanced research equipment and facilities.

Finally, the Center operates a Convergence Technology Commercialization Center(CTCC) that supports the highest level of research infrastructure, including test-bed, test certification/verification and product launch support in order to help ICT SMEs grow into global companies.

R&D Commercialization Department

Based on the research results derived from market and technology trend analysis, R&D Commercialization Department is providing business enterprises with R&D results that contributes to their innovative growth and also focused on promoting high-tech startups that revitalize our economy. For the successful technology commercialization, we conduct market demand survey, make and implement technology commercialization strategy, investigate and analyze the market performance, and technology valuation. In order to help business enterprises utilize technologies they need, our department is providing information on R&D results, establishing a cooperation network with business enterprises, and strengthening cooperation with commercialization related organizations. Besides, we are providing incubation programs that accelerate the creation of technology-based startups and growth support programs for established startups.

Intellectual Property Management Department

Intellectual Property Management Department aims at facilitating commercialization of ICT technologies developed by ETRI through IP management and technology transfer. Also, it plays key roles in acquiring valuable intellectual property rights(IPRs) and boosting commercialization through building and implementing business strategies. In order to realize the economic values underlying our technologies, following activities are performed: acquiring, managing, protecting and licensing IPRs on both domestic and global bases, transferring our own technologies to enterprises, and participating in the international standard patent pools.

Global Cooperation Department

The Global Cooperation Department is organized as a collaborative platform to build the infrastructure required to ensure ETRI's Global competitiveness.

The Department's main tasks are as follows: First, to promote the global spread of ETRI's R&D capability, it is actively promoting joint research with major advanced countries and strengthening R&BD cooperation with strategic partners.

Second, in order to strengthen the cooperation foundation for overseas expansion, it is strengthening the link between the New South-North Policies, expanding support for USA-EU projects, and expanding the platform for discriminatory global cooperation partnerships through the localization of global partnerships. Third, it is conducting various technology marketing campaigns aimed at expanding global business. In particular, it is actively promoting the overseas technology road shows hosted by the government, expanding exchanges of human resources in the technology sector with overseas cooperation partners, and strategically promoting ODA projects for developing countries.

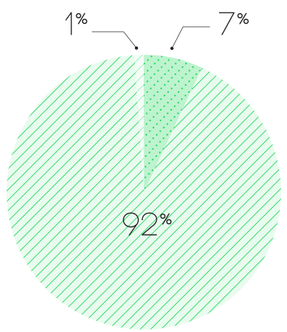
The Global Cooperation Department is promoting the commercialization of global technologies with overseas centers in Beijing, China and San Jose, USA. It also provides various customized marketing services to support the efforts of Korean SMEs - including ETRI-affiliated companies - to advance into overseas markets.

Part.2

GENERAL STATUS

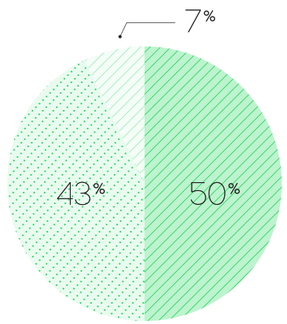
PERSONNEL

As of end of Aug. 2019



Type of Work

- Board Member / Administrative Staff : 166
- Research / Technical Staff : 2,073
- Support Staff : 23



Status of Degree Holding

- Doctoral : 1,115
- Master : 981
- Bachelors : 166

Total

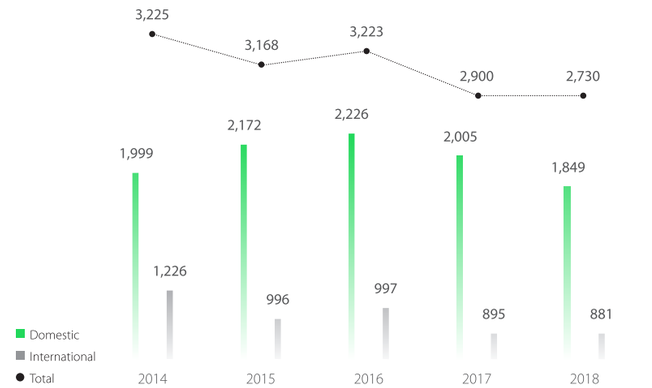
2,262 person

PATENT APPLICATION

Total of past 5 years
As of end of 2018

No. of Patent Application

15,246 cases



Patent Application

(unit : cases)

PROJECT STATUS

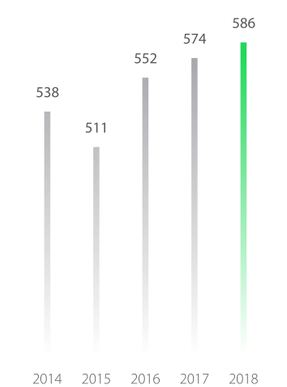
Total of past 5 years
As of end of 2018

No. of Project

2,761 cases

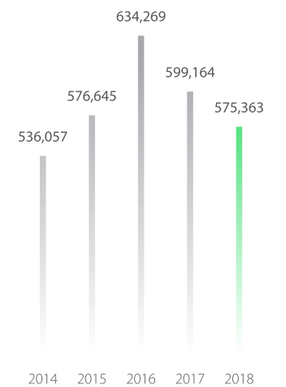
Budget(average)

584,299 million won



No. of Project

(unit : cases)



Budget

(unit : million won)

TECHNOLOGY TRANSFER

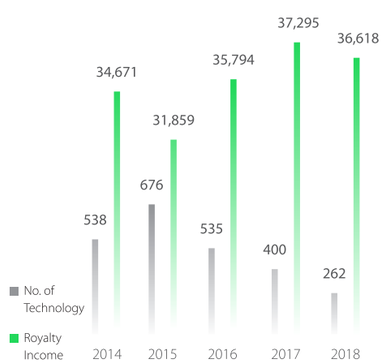
Total of past 5 years
As of end of 2018

No. of Technology

2,411 cases

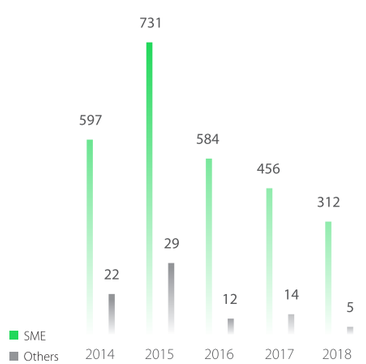
Royalty Income

176,237 million won



No. of Technology / Royalty Income

(unit : cases, million won)



No. of Technology Transfer Companies

(unit : cases)

STANDARDIZATION

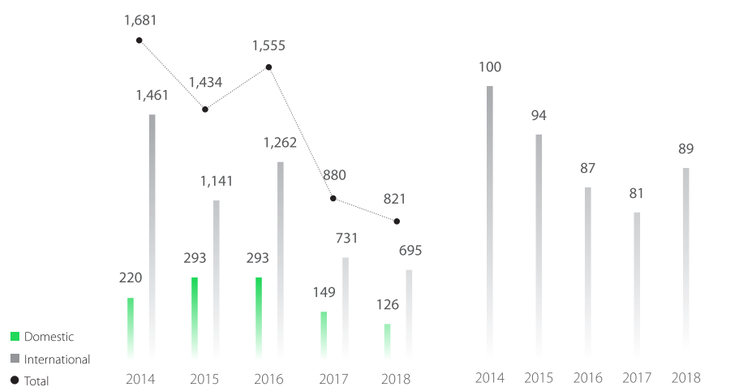
Total of past 5 years
As of end of 2018

No. of Standards Contributions Adopted

6,371 cases

No. of Standard Experts

451 person



No. of Standards Contributions Adopted

(unit : cases)

No. of Standard Experts

(unit : person)

SCI PAPERS & SCI EXPANDED PAPERS

Total of past 5 years
As of end of 2018

No. of SCI Papers

1,087 cases

Average IF

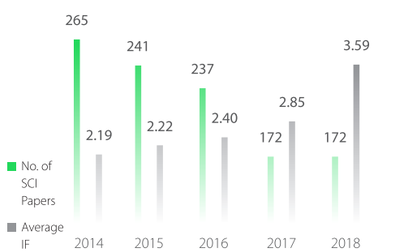
2.65 average

No. of SCI Expanded Papers

1,468 cases

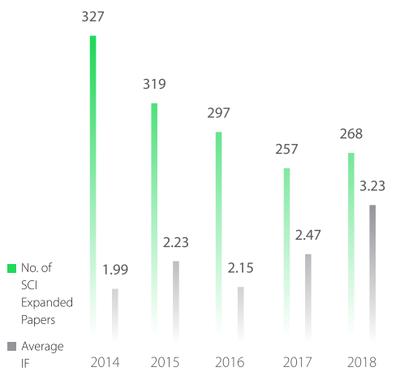
Average IF

2.41 average



No. of SCI Papers / Average IF

(unit : cases)



No. of SCI Expanded Papers / Average IF

(unit : cases)

STATUS AND PROGRESS OF ETRI START-UP

830

Companies

After the establishment of Sambo(Trigem) Computer in 1980 approximately 830 companies have been established

20

Initial Public Offering

20 of ETRI Alumni Companies are listed on the KOSPI [2], KOSDAQ [13], KONEX [5]
(As of 2018)

3,526.6

Sales

As of 2018 / Among 308 Companies
(unit : Billion KRW)

ETRI LABORATORY ENTERPRISE STATUS

Registered Companies

ETRI has set up 57 ETRI Laboratory Enterprises through successful commercialization of research outcomes since 2007.

57 42

Companies in Operation

42 ETRI Laboratory Enterprises in Operation
(As of 2018)

BT works(Co.), Sogware(Co.), Sugentech(Co.), Aritel(Co.), (Co.)Gamdong, Hojeonable(Co.), New-run(Co.), MINDs(Co.), Syntekabio(Co.), Wooksung Media(Co.), Gamma Spectra(Co.), RNSLab(Co.), (Co.)Eintelligence, JSLIDA(Co.), Bird Letter(Co.), HarborMax(Co.), Optella(Co.), icerti(Co.), Gene System(Co.), HANCOM INTERFREE(Co.), ch soulution Co., Ltd, Devstack Inc, WiseThan(Co.), Gridaenergy(Co.), SNET(Co.), (Co.)ELROIS, (Co.)Antrorse, (Co.)To be smart, (Co.)Dark Horse Games, (Co.)Y-tech, Pdxen Inc, MAG-SOLUTION Inc, MINTROBOT (Co.), SecuWorks(Co.), UGS(Co.), Cruxell(Co.), Sharechem(Co.), TexTory(Co.), NDOS(Co.), Bio-SensTechInc(Co.), Greenzone Security(Co.), ALTech(Co.)

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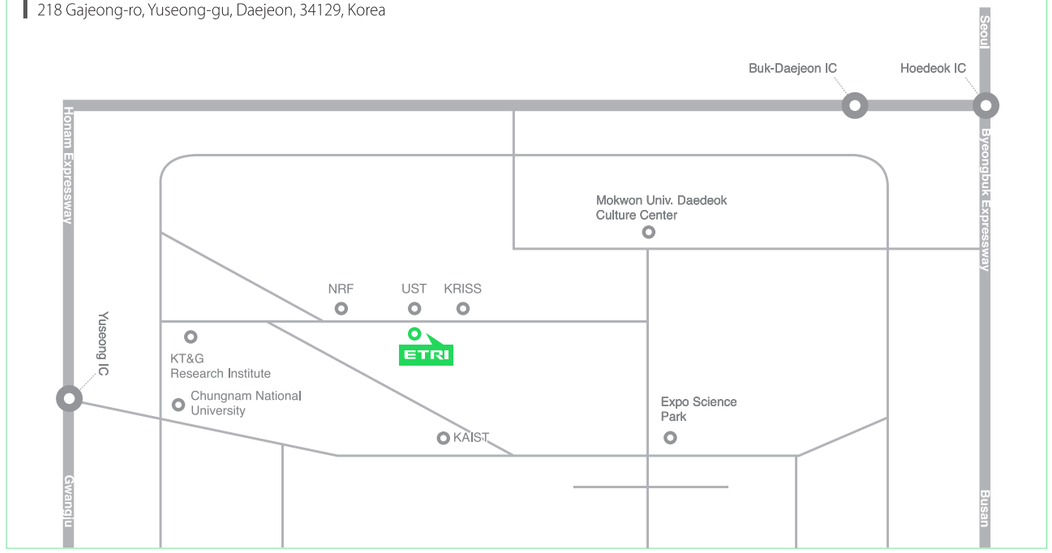

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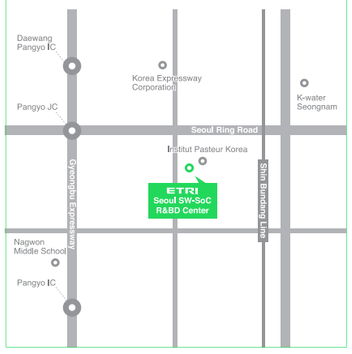

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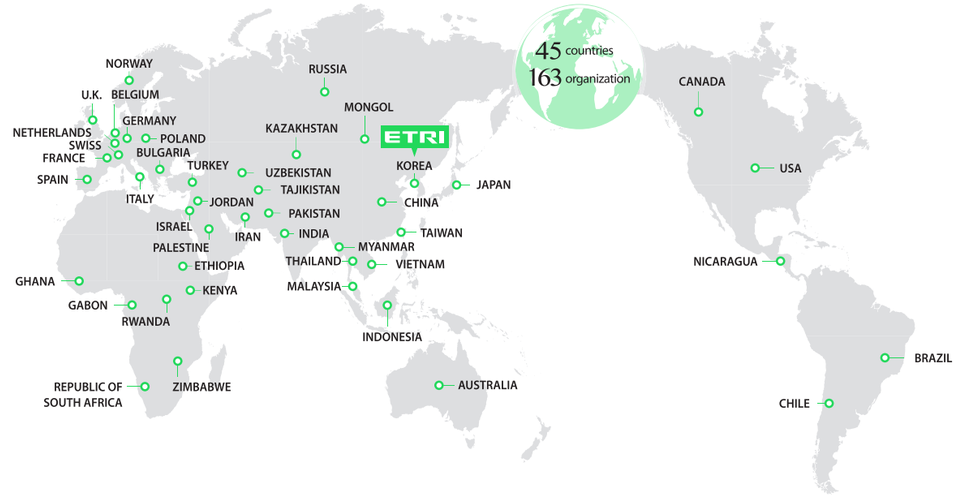
GLOBAL R&D COOPERATION NETWORK



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