



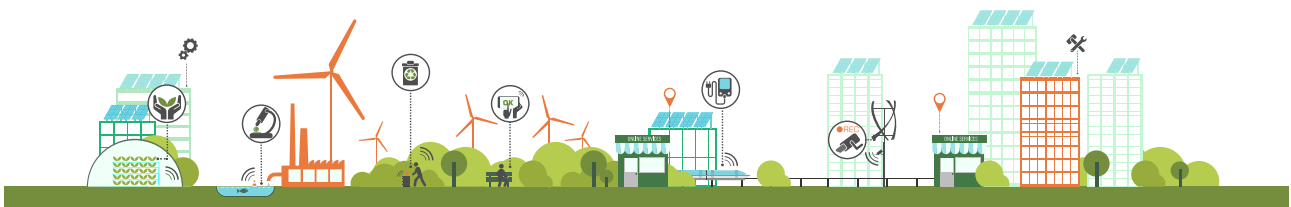
Lead the Development of a Smart City



Sustainable Products and Services

Changes in the global environment and climate have given rise to the idea of low-carbon economy and green consumption. Sustainable products and services will gradually become the mainstream in consumers' purchases, which we believe will be made possible once the smart city and related applications become available.

Chunghwa Telecom remains devoted in green innovation, and strives to accomplish our goals through green consumption, green service, and green activities. We hope to apply our advantages in environmental protection and energy conservation onto existing products and services, as we view business and environmental sustainability our competitive focuses and opportunities. In 2016, there were NT\$ 6.36 billion revenues from green products, which accounted for 2.8% of total revenues.



S trategy

Continue to invest in R&D, and master the key technologies in the field of IoT trends, operational management and business innovation by introducing advanced technologies and the joint ventures with the government and academic circle

M anagement

Established the quality improvement task force, quality assurance center, and business process task force for introducing ISO R&D quality system for integration with the development of competence, project management and system operation

A ction

Continue to present innovative products and create smart cities, including Smart Home, iEN, ITS

R esponse

Please refer to p.55 “The Present Situation and Prospects of Innovative Technology”

T arget

Short-term: Continue to pool momentum for research and development and launch new products and services

Long-term: A 5-year IoT plan has been devised for 2017-2021. The plan involves the construction and enhancement of IoT platform to provide services such as cloud storage and AI for various industries

I ndicator

CHT NT\$ **3.8** billion in R&D investment

CHT **1,488** talents in R&D

CHT **1,649** patents

Participation in the “Taiwan Intelligent Aerotropolis Association”

To assist in the government’s “Taoyuan Aerotropolis Project,” Chunghwa Telecom took the initiative to call local and foreign industry leaders of the same ecosystem into meetings, and was able to reach a consensus in just 2 months’ time while recruiting nearly 70 businesses to form the Taiwan Intelligent Aerotropolis Association (TIAA). Having envisioned “Forge a city of smart logistics and of industrial advance technologies,” the TIAA exists to offer insightful advice to the development of Taoyuan Aerotropolis.

In 2016, TIAA joined Taoyuan City Government in hosting the “Asia Silicon Valley x Intelligent Aerotropolis Forum,” which attracted more than 300 people to participate. TIAA had already completed the proposal of its “Regulatory Guidelines for Establishing Taiwan as Asia Silicon Valley” and made policy recommendation concerning the making of the Asia Silicon Valley. Representatives from National Development Council and Taoyuan City Government were invited to the forum for a briefing of TIAA’s recommendation, so that the industry participants, government officials and the academia could achieve a consensus regarding the Asia Silicon Valley.

*Taiwan Intelligent Aerotropolis Association: <http://www.tiaa.com.tw/>

4G Leads Smart Cities



In 2016, Chunghwa Telecom introduced the theme: “Smart Opportunities through Internet Integration” to demonstrate how IoT and ICT solutions can be used in conjunction with broadband technology to create a smart city. CHT’s 4G Smart City has been supported by 15 counties and cities spreading across Keelung City, Taipei City, New Taipei City, Taoyuan City, Hsinchu County and City, Miaoli County, Taichung City, Chiayi County and City, Kaohsiung City, Taitung County, Yilan County, Penghu County, and Kinmen County, and also 2 specific areas, including Taiwan Taoyuan International Airport and Taoyuan Metro. The service will be expanded and promoted to wider areas in 2017, including Tainan City, highway service areas, and THSR Hsinchu Station.

4G Leads Smart Cities - Accessibility Applications

Chunghwa Telecom is currently a participant in the 4G mobile broadband network smart city subsidy program by the Industrial Development Bureau, MOEA; it has 3 main focuses for building a smart city and leading the new smart lifestyle, which are: convenience, LOHAS, and friendliness. The friendliness focus is mainly concerned with “accessibility applications.” It involves the use of 4G technology to create a living environment that is caring, friendly, and accessible to people with disabilities and the elders.

In 2016, the Company completed accessibility upgrades of 5 streets, 9 MRT stations, 1 campus, 1 shopping district, and 1 activity center. By the end of the year, the accessible facilities were used by more than 7,700 people. At the beginning of 2017, Chunghwa Telecom participated in Mobile World Congress (MWC) and shared its experience on accessible applications and services in the hope of promoting solutions to a greater number of countries to the benefit of people with disabilities around the world.



Lead the Development of a Smart City

Intelligent Energy Network Service (iEN)

There are 3 main aspects to Chunghwa Telecom's iEN service: green energy, green IT, and building energy efficiency. In addition to ensuring the soundness of equipment operations, iEN also delivers a total energy-saving solution for Chunghwa Telecom and corporate customers, which can be utilized to create the optimal energy management environment for benefits such as more efficient system operation and reduction of operating costs.

►Case #1: Building automation

A university contracted for a higher power capacity than it actually used, causing fixed power charges to be set above the actual requirement. In the peak season, however, the university uses power above the contracted volume and is fined for the excess.

iEN solutions

- By collecting power usage information throughout the campus, the Company was able to recommend the optimal contract capacity and save the institution from overpayment.
- Power usage is being monitored and controlled for the entire campus, so that usage during peak seasons can be kept within the limit to avoid fines.

►Case #2: LED road lamp management system

Road lamp management solution

- Features remote monitoring and digital map for a real-time update on road lamp conditions.
- Features luminance control for better energy-saving and cost-saving benefits.
- Features equipment maintenance analysis, thereby enables preparation of spare parts and budgeting of related expenses.

Sustainability in Innovative R&D

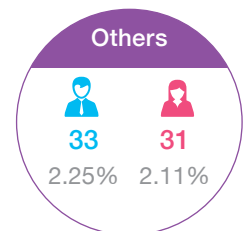
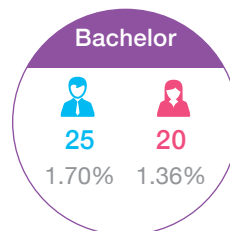
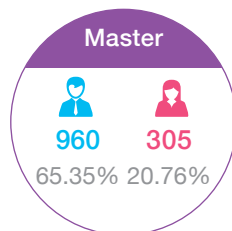
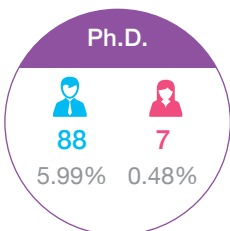
As the leader in telecommunication, we understand that research, development, and innovation are what drive the growth of the business. To maintain our current advantage, we have adopted a visionary and creative culture that focuses on interacting, sharing, and creating mutual benefits with industry participants.

Chunghwa Telecom Laboratories (CHT-TL) is a dedicated research institution commits substantial resources to research and development work. In addition to developing technologies needed by the Company, CHT-TL also plays a major role in the nurturing of new businesses. CHT-TL focuses its research efforts on innovative services, core technologies, and visionary applications and strives to explore convenient and useful services from consumers' perspective, and formulate solutions through intricate coordination. The ultimate purpose is to find ways to "simplify tasks for consumers and let Chunghwa Telecom deal with complexities."

Wireless Communications Lab	Big Data Lab	Broadband Networks Lab	Convergence Services Lab	Information & Communication Security Lab	Business Management Information Lab	Internet of Things Lab	Billing Information Lab	Cloud Computing Lab	Network Management Lab	Business Solution Lab
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Quick View of Chunghwa Telecom Laboratories

- More than 1,469 employees (nearly 6.48% of total employees in CHT), 95% are R&D personnel. The laboratories plan to hire 30 additional permanent staff in 2017.
- R&D expenses totaling NT\$ 3.8 billion were spent in 2016, total levers for 1.6% of consolidated operating revenues.
- In 2016, the laboratories obtained 225 new product/technical patents (212 were registered domestically, and 13 were registered overseas) to a total of 1,649 (1,506 were registered domestically, and 143 were registered overseas). 989 of the patents are currently in force (916 registered domestically and 73 registered overseas).



Awarding Bodies	Award Description
Taiwan Area National Freeway Bureau, MOTC	Big Data Lab Won 2nd place in the competition - "Creative Application of Highway ETC Data for Traffic Management"
Chinese Enterprise Resource Planning Society	Internet of Things and Broadband Networks Lab Co-winner of "2016 International Conference on the Development and Application of Big Data and Enterprise Resource Management - Thesis Award"
Microsoft	Big Data Lab Won Gold Award and Versatile Application Award in the "Open Cloud Data Service and Taipei OMG (Open, Mobility, Green) Traffic Application Development Competition"
Taiwan Association of Cloud Computing	Cloud Computing Lab Won "2016 Cloud Computing and Big Data Analysis Conference - Best Thesis Award"
Ministry of Economic Affairs	Won 1 platinum, 2 gold, 4 silver and 1 bronze in "2016 Taipei International Invention Show & Technomart"
Intelligent Transportation Society of Taiwan	Cloud Computing Lab Won "2016 Smart Transportation Thesis Award Cloud Computing and Big Data Analysis Conference - Best Thesis Award"

Encourage Internal Innovation

We encourage employees to innovate and break through existing boundaries as part of our creative culture. We hosted 2 incentive competitions in 2016, including a Creativity Competition and an Innovation Competition.

The “Creativity Competition” inspires employees to think creatively in ways that expand business opportunities for Chunghwa Telecom. Employees are encouraged to solve problems from customers’ perspective and address various aspects of concern in order to develop feasible solutions. The Creativity Competition received entries from 54 teams. The “Innovation Competition,” on the other hand, encourages innovative research and development as well as out-of-the-box thinking for value-adding improvements to existing products and service procedures. The Innovation Competition received entries from 24 teams.



Lead the Development of a Smart City

The Present Situation and Prospects of Innovative Technology

	2016 in Review	2017 in Prospects
SDN Technology and Applications	Chunghwa Telecom deployed a SDN network with domestic networking vendors including Estinet, Agema Systems, Xinguard, Realtek semi-conductors, III (Institute for Information Industry), and ITRI (Industrial Technology Research Institute) at Exhibition Hall 3 of Taipei World Trade Center, which fully realize fast deployment and agile adjustment.	Build a software-based service-driven ICT network for shortened launch time and to provide one-stop service package and fast delivery. Strengthen consumers’ support to the brand by satisfying their diverse needs.
Defense Solution Against APT	EyeQuila’s solutions are capable of gathering and analyzing information immediately on suspicious websites that it identified, and thereby assist enterprises with information protection and reduce security risks. EyeQuila’s big data APT solution was presented during the 2016 “Taipei International Invention Show & Technomart” and won the Silver Award.	Continually refine enterprise information security technology and assist companies with information protection, and reduce internal security risks; enhance appeals of EyeQuila products and support the business department in generating revenues.
Smart Environment Solutions	Completed functional modules including effluent monitoring, DMA section measurement, etc. for real-time monitoring of water pollution and discharge. Any abnormal discharge can be alerted and reported to facilitate emergency response and improvement, which contributes favorably to environmental protection.	Support the government’s solar energy initiatives by developing solar power equipment management systems. These systems gather information on power stations in real time, and send the alert when power efficiency falls below a certain level so that improvement measures can be taken in advance.
B4G/5G Technology	Chunghwa Telecom hosted NGMN’s first member conference in Taiwan. Through interactions with world-renowned carriers, we helped connect Taiwan’s telecommunication industry with the rest of the world. At 3GPP, the Company successfully standardized specifications for dual-band, tri-band and quad-band carrier aggregation based on the release of 4G bands in Taiwan, and contributed to the competitiveness of Taiwan’s mobile network. At NGMN, Chunghwa Telecom explained the legal implications and practical applications of 5G spectrum in Taiwan so that the 5G Spectrum was published after taking into account all legal and practical concerns in Taiwan.	The Company has devoted itself to the development of mobile IoT communication technology, and invested into the research of Cat.M and NB-IoT technologies based on the existing 4G LTE infrastructure. In addition to engaging 3GPP, NGMN and other organizations relevant to the creation of 5G standards in technical discussions, Chunghwa Telecom will also construct an end-to-end experimental NB-IoT network that can be implemented at an appropriate time to begin mobile IoT service within the nation. We realize the government’s vision to “drive economic growth through innovation, and promote industry transformation through IoT.”

Pre-5G NB-IoT Testing

Driven by a dedication to innovative research and service, Chunghwa Telecom joined Nokia and led the nation in the testing of NB-IoT (Narrow Band Internet of Things) over Chunghwa Telecom's 4.5G network. In doing so, the Company contributes to the development and popularity of IoT applications in Taiwan.

We have collaborated with Nokia to install smart outdoor sensors with built-in NB-IoT modules at farmhouses located in Taoyuan City. The sensor gathers environmental data such as atmospheric pressure, humidity, temperature, etc. and transmits them to data users far away for real-time monitoring and analysis. The project helps detect frost damage on crops and enables analysis of climate impacts on crop growth. Other possible applications include air quality monitoring, water quality monitoring, and pet tracking.

The difference between 5G and 4G lies in the connection between objects. NB-IoT is the current IoT technology used in the Pre-5G stage; it has many advantages such as wide coverage, low power consumption, low cost, large-scale connection support, stability, reliability and security that make it suitable for IoT applications including smart meter, smart road lamp, and smart parking. It has been regarded as the leading technology for 5G IoT applications, and is believed to have the potential for vertical applications.



National Time and Frequency Standards - Leap Second Service

Chunghwa Telecom has been commissioned by the Bureau of Standards, Metrology and Inspection, Ministry of Economic Affairs, to maintain time and frequency to the highest standard. It compares data with the rest of the world to ensure consistency with global standards. Chunghwa Telecom is a participant of International Bureau of Weights and Measures (BIPM), and joins other participants in maintaining Coordinated Universal Time (UTC) and International Atomic Time (TAI). Domestically, Chunghwa Telecom serves as the common source for all time-frequency analyses and calibrations performed by local businesses; it distributes national standard time via telecommunication technology to satisfy the public's need for standard time.

The “Cloud Valley” Project

Chunghwa Telecom has been working closely with Cloud Computing Association in Taiwan for a project named “Cloud Valley” since 2013. With the support of technologies, guidance and fundings from the association’s prominent members, Cloud Valley has been vested the hope of discovering future talents/entrepreneurs in Taiwan’s cloud computing industry, and becoming the model industry cluster. In 2016, Division Chief Jao of Chunghwa Telecom’s Data Communications Business Group was assigned to counsel 2 new businesses for the finalist competition in Cloud Valley, which they both delivered extraordinary performance.

*Cloud Computing & IoT Association: <http://accelerator.twcloud.org.tw/>



Innovative Application Challenge - Nurturing Creative Minds

Chunghwa Telecom’s innovative application challenge has been running for nearly 10 years. We provide an open platform and invite passionate students and working adults to turn creative ideas into useful apps, microfilms and children’s e-books. Through this competition, we have established communication between creators and business users, and gave them the opportunity to observe, learn and inspire one another and take creativity to a whole new level.



1.Hami Apps Development Challenge

More than 10,000 students have participated, and more than 1,000 mobile applications have been completed since the challenge first began. In 2016, a total of 153 applications were submitted and listed, accumulating 2 million downloads in total. Overall, the submissions exhibited significantly higher quality and commercial value than before.

2.MOD Micro Film Competition

Amongst all microfilm competitions in Taiwan, MOD receives the highest number of entries and offers the largest rewards. After collaborating with Taipei Film Commission and Micro Movie Association in 2015, Chunghwa Telecom invited ELTA Technology to be a co-organizer in 2016, and offered an exclusive script award plus subsidies to assist in the filming of winning scripts.

3.FunPark – Creative Storytelling

“FunPark” is the nation’s first digital creative platform for children’s publications. It is where students are inspired to create stories, and the winning pieces are published into personalized interactive digital illustration apps with the help of a professional editing team.

A total of 134 schools participated in the program in 2016, and nearly 60 campus tours were organized to reach more than 1,500,000 students, teachers and parents. The winning pieces were viewed more than 525,000 times. The 4th year of competition had a stronger lineup of winners, adding to a total of 53 publications on “FunPark.”