**Global Telecom Operators Applying AI Technology**

1. **The relationship and cooperation between AI and telecom operators**

On 2016, the competition between AlphaGo and Lee Sedol was known to all the world, which let the public gain more knowledge about artificial intelligence. The prospect of artificial intelligence attracts extensive attention, especially in some industries such as internet corporates and telecommunication operators. There are approximately eight hundred and sixty telecommunication operators worldwide, some of them have already noticed the significance of integrating AI into their own business system. AI can do computer vision, speech recognition, and natural language processing technologies, corresponding to seeing, listening, and understanding things just like human beings, which can be used in telecom operators to improve their work and satisfy their customers. To combine AI and telecom operators well can utilize respective advantages to further business innovation. “No matter you care about it or not, like it or not, the era of AI is coming”. This report will investigate the application of artificial intelligence in telecom operators.

1. **The application of artificial intelligence in telecom operators**
   1. **China Mobile**

China Mobile Communication Corporation (CMCC), founded on April 20, 2000, is the leading power of Chinese state-owned telecom operators with a market value of $215.3 billion. It also becomes the top telecom corporation in the world with approximately 873 million subscribers. CMCC provides mobile voice and multimedia services based on GSM, TS-SCDMA, and TD-LTE networks. The major service brands consist of M-ZONE, Easyown, GoTone, G3, and “and”.

On December 2016, China Mobile announced *Intelligent Product and Service White Book* to provide a series of intelligent products and services, and acquired periodical achievements such as image recognition, semantic analysis, automatic speech recognition. Hereafter, China Mobile has begun their exploration and application on artificial intelligence.

* + 1. **Platform**

On November 24th, 2017, China Mobile launched the first artificial intelligence platform named “Jiu Tian”. “Jiu Tian” is focus on telecom operator’s market operation, network, service, and other application areas. For its vertical industry, it provides end-to-end AI application solution and implementation in an application scenario driven manner. This platform consists of three layersA close up of text on a black background

Description generated with very high confidenceThe top layer is about the product application, which contains smart decision, smart network, smart customer service and other areas; the second layer is the core capabilities layer, which includes the types of speech and semantics analysis, image recognition, and data visualization; the bottom layer is base service, which consists of deep learning platform based on GPU and other infrastructures.

* + 1. **Alliance**

China Mobile allies itself with other countries’ telecom operators to explore the application of AI. On 2017, China Mobile and AT&T set up ONAP project to develop a periodical management platform for SDN/NFV network. On 2018, China Mobile, AT&T, Deutsche Telekom, DoCoMo, and Orange made an alliance named “Ohrand” to achieve the goal of opening, open-sourcing, and intelligence the core network and unlimited network. On May 2018, China Mobile joined AIIA.

* + 1. **Product**

**Smart Home:**

China Mobile mainly produces smart home, smart city, smart network, and smart government enterprises. The company released smart home “Andlink” agreement that can achieve interconnection and coordinated control between multiple smart homes, and create a comfortable, convenient, healthy, smart, and safe living space for their customers.

**Smart City:**

Smart city is based on plenty of customer data to open basic communication, internet of things, big data, cloud computing and other advantages. China Mobile has cooperated with more than 300 cities to develop smart city in 10 industries.

**Smart Network:**

Smart network consists of three systems. ACOS is based on deep learning can intelligent analyze community coverage problems, output optimization proposal, and enhance the network coverage quality of the community. APOS, intelligence parameter optimization system, is supported network optimization through abundant algorithm and flexible invocation forms. AIOps, intelligent operation and maintenance system, provides smart site portrait, hidden danger prediction and management, facility information statistics, unstructured date extraction and other capabilities, which efficiently reduced workload of operation and maintenance personnel and increase the efficiency of operation and maintenance.

**Smart government enterprises:**

Smart government enterprises construct four product systems, which are “video+”, “safety+”, “work+”, and “cloud+”. It provides intelligent solutions in eight vertical industries, they are government affairs, finance, transportation, education, medical, internet, and industrial energy resource.

* + 1. **Standard**
    2. **Project**

On November 2017, CMCC and AT&T jointly issued one of the largest open source projects in the world - ONAP. ONAP focuses on real operator scenario, and commits to build an open source implementation of next-generation network automation management and orchestration system. Amsterdam, the first edition of ONAP, implements the end-to-end business collaboration and life cycle management based on NFV/SDN. Amsterdam can support Vcpe, vVoLTE, and other business scenarios. CMCC lead the completion of technical framework design and platform core code development, and built the integrated validation laboratory, which guaranteed the delivery of Amsterdam. Successfully launched Amsterdam helps the transformation and upgrade of the operator network. ONAP has attracted 57 corporation partners globally within one year.

* 1. **China Unicom**

China Unicom is a Chinese state-owned telecom operator that founded on July 19th, 1994. China Unicom is the world’s fourth largest mobile service provider. Its core business operations are GSM and WCDMA mobile communication service, domestic and international direct dial service, local call service, data communication service, internet service, IP telephony service, satellite communication and other telecom services.

China Unicom applies AI technology to realize relevant businesses and services and improve user experience in terms of voice, image and natural language processing. Meanwhile China Unicom has been actively exploring the possibility of the application of AI technology at internal and external levels.

* + 1. **Platform**

China Unicom will build an intensive, comprehensive, intelligent and enabling cBSS core business support platform to achieve one-point butt joint, national implementation and rapid iteration

* + 1. **Alliance**

1. China Unicom has cooperated with Tencent to launch cloud solutions for medical image application scenarios by using image recognition and deep learning technology automatically recognize medical images such as CT and MRI of patients. It helps doctors to improve the diagnosis efficiency.
2. China Unicom collaborated with other companies to integrate smart driving and communications technology. China Unicom did real – car test in the national intelligent network automobile test base in Shanghai. It successfully exhibited a cellular car networking (C-V2X) application solution that supports multi-scenario integration
3. On October 2017, China Unicom promoted the establishment of AIIA and was elected as the vice president. Also undertook AIIA Artificial Intelligence tour - China Unicom & Tencent competition site
   * 1. **Product**

**Smart Home:**

China Unicom has developed set-top box, TV and other products based on speech recognition technology. It also launched smart speaker.

**Smart City:**

China Unicom is the overall responsible unit of XiongAn digital project. It provides smart city solution for XiongAn and uses Artificial Intelligence technology to realize the construction of smart city infrastructure.



**Smart Network:**

China Unicom Institute of Network Technology launched "AR intelligent operation and maintenance system, construct China Unicom network security situation perception analysis system. China Unicom has started the AI related research and applications on the network planning, network design, network maintenance, network optimization, SDN/NFV, 5G edge computing and IoT. China Unicom is also planning for the network brain project.

**Smart government enterprises:**

China Unicom actively introduces artificial intelligence technology into "XueLiang Project". It combines face recognition, license plate comparison, big data analysis, comprehensive layout control and other technologies with the construction of county, township and village comprehensive centers to reach precautionary measure to citizens. In 2018, China Unicom set up a “Wisdom Coalition” to aggregate industry partners’ power and wisdom in the new retail, Internet consumption, industry Internet and other aspects to develop comprehensive, deep and systemic comprehensive cooperation.

**Customer Service:**

China Unicom has launched an efficient and intelligent online customer service, which combines human service and robot independent service to create a high-quality service experience. It also launched Wobao, an intelligent robot, to answer all kinds of business questions. China Unicom has deep corporation with Baidu, Ali and other Artificial Intelligence to further export intelligent call center cloud solutions to financial insurance and other industries, which effectively improve customer perception and reduce enterprise’s operating costs.

**Industrial Application:**

On March 2018, China Unicom has completed the world's first 4G network-based flight measurement and control test of a long-distance high-altitude industrial UAV. It successfully realized the oversight flight of UAVs in highland and mountain areas by using operator network. China Unicom has applied the artificial intelligence vision technology to the intelligent video monitoring of key areas such as river (lake) road, reservoir and sewage outlet by connecting smart river length solutions.

* + 1. **Standard**

1. On January 2018, the ITU-T IoT and smart cities group (SG20), led by China Unicom and Fiberhome Technologies, has set up the first Artificial Intelligence standard and established ITU ML5G Machine Learning focus group.
2. China Unicom’s three achievements are listed in AIIA "*Chinese excellent Artificial Intelligence technology and application case set*".
   * 1. **Project**
   1. **China Telecom**

China Telecommunications Co., Ltd is an integrated information service provider, and is one of the listed companies of state-owned China telecom corporations. China Telecom provides fix-line telephone service, mobile communication service, satellite communication service, internet access and application service, and other integrated information services. The company’s brands include e-Surfing Pay, e-Surfing Media, e-Home, and best tone.

China Telecom actively promotes intelligent network reconstruction and focus on building a new generation of intelligent network of "Internet of Things, man - machine interaction ". China Telecom will use emerging technologies such as Artificial Intelligence, big data and cloud computing to "inject intelligence" into economic and social development.

* + 1. **Platform**

On January 26th, 2018, China Telecom launch Artificial Intelligence open laboratory named “Deng Ta” AI open platform. “Deng Ta” consists of three layers, the top layer is application layer includes security, Finance, self-driving, smart city, smart speaker, smart livestock and Medical image diagnosis; the middle layer is capability layer includes image, video, phonetic and natural language processing; the bottom layer is base layer includes deep learning platform “DTaas”.

A close up of a map

Description generated with high confidence

The platform’s features are 3+1+1 product system, which are market research + precision marketing, O2O customer insight, smart city + capacity platform. Multi-source data integration includes tele-data, Internet data and third-party data. Model training, evaluation and prediction to easily implement the Artificial Intelligence algorithm

* + 1. **Alliance**

In May 2018, China Telecom was appointed as the vice President of AIIA.

* + 1. **Product**

**Smart home:**

China Telecom arranges smart home areas and corporates with Intelligent terminal manufacturer introducing smart speaker, smart Internet, smart gateway, smart set-top box and other product groups. China Telecom develops smart home unified mobile phone clients and open platform to provide smart living solutions for clients and offer collaboration opportunities for industries.

**Smart city:**

China Telecom has signed strategic cooperation agreements with 236 cities across the country and cooperate in e-government, safe cities, environmental protection, health care, education and cultural tourism. In addition, China Telecom plans to build a smart city management platform.

**Smart network**

China Telecom has released the *CTNet2025 network architecture white paper* starts intelligent network reconstruction. China Telecom introduced SDN, NFV, cloud and other technologies to build a new generation of intelligent network operation system that is concise, intensive, agile and open. It provides users with a visual, optional, self-service network experience.

**Smart government enterprises**

China Telecom collaborated with NetEase launched the enterprise communication platform, using the advantages of Internet + communication integration, promote the intelligent office, develop its service ability, expand the scope of services and develop the enterprise market. On May 2018, China Telecom has established the e-surfing cloud security ecological alliance that create a more secure and credible cloud service for government and enterprise customers

**Customer services**

China Telecom's intelligent customer service robot Xiaozhi combines core technologies such as neural network, deep learning, voice recognition, natural language processing and context scene interaction, provides 24/7 intelligent response service to users through human-computer interaction, and provides more than 40 million services a month. In addition, China telecom structures intensive "smart customer service cloud platform", using intelligent voice, semantic identification technology and improve customer service experience.

**Industry application**

China Telecom's intelligent data center includes customized servers, cloud pipe platform, a AI-based data center energy-saving; AI PaaS platform includes Caffe for image analysis, TensorFlow for large-scale in-depth learning, and knowledge map for professional fields.

China Telecom has developed an in-depth search system, which focuses on the field of text information processing and is used in semantic search, automatic question answering robot, social media mining, data analysis and decision-making

China Telecom has developed an intelligent relationship insight system, which builds association discovery model and emotion analysis model through neural network

China Telecom’s independent research system based on Artificial Intelligence and big data analysis technique assist polices intelligent deploy forces, depth excavation clues, intelligent analysis of potential threats, which improves efficiency of police work.

* + 1. **Standard**

1. In February 2017, China Telecom collaborated with Huawei established ENI, the first global network Artificial Intelligence standard working group in ETSI. In May 2018, China Telecom issued international technical standard for the first global network Artificial Intelligence demand.
2. In April 2018, China Telecom alliance with other industries issued the *Network Application of Artificial Intelligence White Paper*. It is the first giving the definition, connotation, the typical application scenarios and future network Artificial Intelligence application framework to Artificial Intelligence network.
   * 1. **Project**
   1. **AT&T**

AT&T is the acronym of American Telephone & Telegraph and founded in 1877. AT&T is the biggest fixed-line telephone service provider in the United States, and is the second largest mobile telephone service provider with the market value of $245.58 million.

AT&T has always used artificial intelligence, but only developed applications on its own. Now, AT&T decided to build a universal AI platform that will solve all kinds of problems. AT&T hopes the new platform will be able to predict events such as system failures rather than react to them, and such the AI systems can ultimately change the way they operate by predicting events.

* + 1. **Platform**

On 2017, AT&T cooperated with Tech Mahindra launched an open resources platform named Acumos, hosted by the Linux Foundation. Acumos aimed to make the creation, sharing and deployment of AI applications more easier and lower the costs. The platform would also provide a market for accessing, using and enhancing these applications. It allows developers to edit, integrate, write, package, train and deploy AI and machine learning applications. The team of Acumos dedicated to set up an industry standard for AI application and reusable model.

* + 1. **Alliance**

1. AT&T collaborated with IBM on the design, development, and deployment of all-new microservices supplier program, which is to provide an innovative way in delivering the service function. With the successfully implement, AT&T will achieve faster capacity updates and alter its business backend processes. According to the long-term strategic relationship between AT&T and IBM, IBM will focus on creating microservice that will modernize the application program and transform service processes, which includes sell, order and enterprise data. This will enhance the performance of backend processing and lower the downtime to enables rapid and easy deployment of access to new services and functions.
2. AT&T initiates the Smart Cities Strategic Alliance with Synchronoss and Ubicquia to build a better smart city. Synchronoss helps AT&T to provide cloud, messaging and digital products while Ubicquia providesa plug-and-play network to AT&T, which can help provide broadband, small cell and smart city services.

* + 1. **Product**

**Smart City:**

AT&T collaborated with Cisco, Deloitte, Ericsson, GE, IBM, Intel, and Qualcomm Technologies, Inc. to set up a new smart cities framework, helping cities better serve their citizens and building more connected communities. The new smart cities framework will be used in Atlanta, the Georgia Institute of Technology, Chicago and Dallas. The new framework works on the categories consists of infrastructure, citizen engagement, transportation, and public safety.

* + 1. **Standard**
    2. **Project:** ONAP
  1. **Verizon**

Verizon Wireless is the largest wire communication, voice communication, and wireless communication service provider in the United States. Verizon has a very high reputation among their customers because of its high intensity of signal stations, and broadly and stably covered signal. Verizon is also the largest printing yellow page company and yellow page online information provider.

Verizon’s AI deployment is mainly in the IoT area. Verizon bought Hughes Telematics, a company develops vehicle-mounted information and communication systems; Telogis, a private care IoT technology company; Fleetmatics, a GPS vehicle tracking company; and Sensity Systems. An IoT start-up. These acquisitions demonstrate its layout and ambitions in the IoT. In its vertical sector, Verizon launched the ThingSpace platform, which helps developers develop applications and quickly market their products.

* + 1. **Platform**

1. Verizon unveiled “Exponent”, a combination of software and online platforms that aim to provide new platforms for the IoT, big data and media. As operators around the world seek to compete with emerging technology operators and OTT service providers, Exponent provides a cost-effective way using its experiences as America’s largest network operator to provide professional knowledge and tools to other service providers, and help them speed up the growth and optimize performance. Exponent consists of five key domain platforms:

* Big Data and AI Platforms, which designed to help operators apply advanced Machine Learning technologies, in-depth analysis and Artificial Intelligence;
* IoT Platform, which eliminates restrictions on operators' ability to manage increasingly complex connected devices;
* Media Services Platform, use the top cross-platform video and media services through the network to reduce complexity, and enable operators to deploy several types of content, including 360 video and virtual reality, etc.;
* Internet Services Delivery Platform, aims to help operators create revenue-generating network services and provide dynamic network optimization functions;
* Cloud Computing and Storage Platforms, using a container-based architecture, allow carriers to quickly deploy new services emphasizing on scale and security. (McCann, 2017)

1. Verizon launched a new IoT platform called ThingSpace as part of its strategy to lift it up from the IoT leadership. Verizon used the platform to help developers exploit their apps and quickly market their products. Verizon has targeted many vertical industries, notably health care, agriculture and the sharing economy, typically in the form of university student car sharing. ThingSpace offers partners who are seeking to reduce the cost of launching IoT solutions with features like code databases, pre-installed capabilities and other tools. ThingSpace allowed Verizon to get involved in consumer-oriented M2M solutions, rather than just industrial or corporate applications. (Jane, 2015)
   * 1. **Alliance**
     2. **Product**

![A picture containing screenshot

Description generated with high confidence]()

Verizon has officially launched a “software-defined wireless network + Artificial Intelligence” service, which uses Mist System’s technology to make corporate wireless network and Bluetooth-enabled devices connected to the network visibly. This is based on the Artificial Intelligence and Machin Learning technology of SD-WLAN that can be automatically monitoring the wireless networks in real time, as well as analyzing network and user data in real time to achieve the network fault prevention and self-healing, prevent unauthorized terminal to access networks, meanwhile allowing users independently access network and do the security settings. SD-WLAN also taps AI-driven Bluetooth capabilities. It uses virtual beacon and next-generation positioning technologies, which is convenient for business and enterprise customers to have deeper communication with their employees and customers through the "target proximity message"; making the asset tracking easier; enables location-based security and sensor control with the integration of IoT equipment and easy to upgrade and rich data analysis. (Inc, 2018)

* + 1. **Standard**
    2. **Project**
  1. **Sprint**

Sprint Corporation, founded on 1938, is the third largest mobile operator in the United States. Sprint provides long distance communication, local services, and mobile communication services and other telecom services to 26 million customers in over 100 countries and areas. It has the first nationwide and full digitalization optical network, and Tier 1 IP network. Besides, it owns the largest scale of 100% digitalization and nationwide PCS.

* 1. **NTT DoCoMo**

NTT DOCOMO, Inc., founded in 1952, is the predominate telecom operator in Japan has over 60 million subscribers. The company name DOCOMO means “Do communication over the mobile network” It is the earliest corporation to research and operate telecom services in Japan. Its major brands are i-model, FOMA, and Osaifu-keitai.

* + 1. **Platform**

NTT launched the "Corevo" AI platform, mainly studying the four directions of "Agent-AI", "Heart touching-AI", "Ambient- AI" and "Network-AI". “Agent-AI” uses to analyze the information send out by human beings and understand the intention and emotion in the information to achieve advanced communication and interaction with human beings. “Heart-touching-AI” mainly used to analyze the unconsciousness and un-conspicuous aspect of the individual’s mind and body and to analyze and understand people’s deep psychology, intelligence and the state of instinct. It first understands A screenshot of a cell phone

Description generated with high confidencehuman beings’ cognitive mechanism, then realizes the humanized characteristics. “Ambient-AI” uses to analyze and understand everything in the world includes objects, people, and environment and to predict and control them in real time. “Network-AI” uses to organically connect and cultivate multiple types of AI and optimize the entire social system. Re-evaluate the network from an AI perspective to see if it can create a new social system as an infrastructure. Corevo are being used in many commercial services.

* 1. On December 2016, NTT West launched a small humanoid robot Sota that capable of providing services in English and Chinese, and connecting to NTT AI cloud platform Corevo to provide sightseeing guide services to foreign tourists. With the help of Corevo, Sota can get information about foreign travelers’ nationality and the duration of their trips from the conversations of foreign tourists. In addition, Sota will provide the attractions of Kansai area through the digital board. In addition, Sota provides elderly care services.
  2. NTT DoCoMo announced to cooperative development a voice interactive AI robot with startup company Jupiter and scheduled to launch it in mid-2017. According to the official website of NTT DoCoMo, this AI robot looks like a ragdoll, the front is equipped with a 4-inch touch screen and lens module, and can connect to NTT DoCoMo cloud platform via Wi-Fi that enables users to identify faces through the built-in image recognition function. Furthermore, the cat voice interactive robot uses a core AI technology called Corevo, a natural conversation platform developed by NTT DoCoMo, not only can understand the content and intention of any users’, but also having conversation with users according to users’ preferences. The robot can also search on the internet and provide Weather, news and other contents by voice.
  3. The application of NTT DoCoMo on AI cloud platform Corevo is not only for service robot applications, but also for in-vehicle infotainment. Corevo can be imported into an on-board device sold in Jupiter to provide instant event information, road traffic congestion information and other services subscribed by users. Users must pay the service fee of Corevo, which is one of the income of NTT DoCoMo.
     1. **Alliance**

1. On April 2015, NTT cooperated with Mitsubishi in Tokyo, UFJ Bank to introduced humanoid robot NAO and connected to the natural conversation area of NTT DoCoMo AI cloud platform via Wi-Fi. NAO provides customer-related services include using Japanese, Chinese, English and French chat with customers while they are waiting.
2. NTT Group and Tokyo Motor corporation have reached cooperation agreements on the development, validation and standardization of technology related to networking vehicles. It aims to combine Toyota’s automotive related techniques with the information communications technology of NTT Group. The two corporations will jointly develop the technologies needed to solve social problems such as traffic accidents and traffic jams, and provide new mobile services to customers. The goal of the collaboration is to achieve a sustainable “smart mobile society” globally in the future. The major corporation fields are data collection, accumulation and platform analysis, IoT and data centers, the communication technology of the new generation such as 5G and edge computing, and agency.
3. On May 2018, NTT and NTT DATA have appealed to the insurance industry to seek cooperation in applying the artificial intelligence "life habit disease risk prediction technology" to the insurance business. If the validity of this technology can be verified, it will be helpful for the development of insurance company's products and the review of insurance. NTT has developed a technique to predict the risk of lifestyle diseases represented by diabetes, hypertension and high blood lipids based on physical examination data. The technology was developed successfully because of the results of sequencing learning and analysis using data from uninfected people with short data storage time
   * 1. **Product**

**Smart City:**

The NTT Group has deepened its partnership with Dell technologies to development the smart city initiative. As the part of the city's digital transformation, the two companies will cooperate with the city in its first demonstration of a smart city concept. The smart city solution is based on the innovative Cognitive Foundation architecture of NTT Group, which enables the long-distance creation, management and operation of ICT resources from devices and networks to the cloud. In addition, it will also combine the Dell EMC super-fusion infrastructure and the IoT gateway, as well as the VMware vCloud NFV platform hosting predictive analytics applications. Once the concept validation is complete, it will be able to leverage active data analysis to improve security. With a strong, scalable infrastructure that supports video situational awareness and sensor data, citizens in Las Vegas can use machine learning to shorten the response time of public security events. The NTT Group plans to launch other similar programs in other U.S. cities after the concept demonstration in Las Vegas proves successful.

**AI Guardsman:**

NTT East collaborated with tech startup company Earth Eyes to launch a AI Guardsman, a machine learning system. Depending on Carnegie Mellon University’s open source technology, it can effectively analyze suspicious behavior and identify the potential pickpockets through scanning the live video streams form stores’ cameras. If the device detects a suspicious situation, it will send an alert to a store clerk’s smartphone and send a mugshot and location of the suspect.

Shabette concier (speech assistant software) 2012

OhaNAS (chat robot sheep) 2015年

Hands-free video phone (glasses) 2012

* + 1. **Standard**
    2. **Project**
  1. **Softbank**

Softbank Group Corp. is a telecom and media corporation, which includes services like broadband, fix-line phone, e-commerce, internet, internet telephony, technology, holding, finance, media and marketing and so on. On 2001, Softbank launched “Yahoo! BB” service, which provide broadband ADSL service to Japanese customers. Then, Softbank entered the telecom service field and became the leading corporation in Japanese telecom market.

* + 1. **Platform**
    2. **Alliance**
    3. On May 19th, 2017, SoftBank and Saudi Arabia's sovereign-wealth fund launched the world's largest technology fund, nearly $100 billion, will invest in cutting-edge technologies includes Artificial Intelligence, robotics and semiconductors to U.S. startups and other global firms.
    4. Softbank and Inuitive ltd. announced a partnership to develop Artificial Intelligence, Deep Learning, and advanced 3D sensing with computer vision capabilities for the future of the IoT. The cooperation will make use of the expertise of both companies in the field of Artificial Intelligence, it is using Inuitive’s VPU and framework of AI, coupled with Softbank’s IoT platform that can provide embedded products with advanced heterogeneous processing capacity. The cooperation of these two companies expect to promote the popularization and development of intelligent IoT’s devices and systems. (Inuitive and SoftBank to Collaborate on AI and IoT, 2017)
    5. In 2016, Softbank cooperated with IBM to launch a humanoid robot Pepper on Consumer Electronics Show. Watson is IBM's artificial intelligence computer, not a robot. Watson can analyze data, provide advice, and understand human languages. Developers can integrate Watson into their own applications and devices to make their products smarter. Pepper integrated with Watson can analyze social media, videos, images, texts and other data. IBM said Watson allows Pepper to understand more types of problems in real time, so Pepper can handle more types of affairs. (IBM Watson to Power SoftBank Robotics' Pepper, 2016)
    6. **Product**

Softbank set up Cocoro SB's AI company. Its main AI technology is "emotion engine", which is a technology that uses information from a variety of sensors to simulate the brain secretion produced by five human senses after external stimulation, and then displays emotion on connected cloud computing AI. “Emotion engine” mainly includes emotion recognition engine, emotion generator and chat engine of natural language processing. The technology is currently used in "pepper" emotional robots and the emotional car, NeuV, in partnership with Honda.

1. Chinese domestic appliance manufacture Haier recently announced a partnership with Japan's SoftBank Robotics Group. The humanoid robot Pepper developed by Softbank will be launched in the field of Haier's "smart stores" and "smart homes". Pepper is expected to become the center of Haier's smart home in the future. Pepper is linked to water heater, air conditioning, purifier and other products, combining with temperature and humidity, air quality in the house automatically adjust the indoor environment. Pepper can also connect to electric equipment such as oven and oil absorption help users to realize automation in other ways. In Haier's "smart store", Pepper will serve as a product guide to introduce product information to customers and demonstrate the operation mode of appliances for customers through Haier's U+ system. Pepper can also help Haier stores collect customer feedback, conduct product research and count store sales.
2. Honda's electric concept car NeuV, displayed at the consumer electronics show in 2017, is powered by the "emotion engine" built by Cocoro SB, which is a cloud-based AI technology research and development company owned by Softbank. The car uses information gathered through the system to determine the driver's emotion and learn to react appropriately to communicate with drivers.
   * 1. **Standard**
     2. **Project**
   1. **KDDI**

KDDI is a Japanese telecom service provider founded on 1953. It owns five service brands they are “Au” provides mobile communication services based on 2G, 2.5G, and 3G network; “TU-KA” is only provide 2G service; “Telephone” provides international long-line service; “For Business” mainly provides solutions of VPN and Data Center that aim to corporation customers; “DION” provides ADSL and FTTH network connection service.

* 1. **Vodafone**

Vodafone Group plc., headquartered in London, is a British transnational mobile phone operator. Vodafone is one of the largest mobile communication network corporations, and make investment around 27 countries. Vodafone collaborate with other 14 countries’ local mobile phone operators on mobile phone network service. The name of Vodafone means Voice, Data, and Phone, which is also its global strategy.

* + 1. **Platform**
    2. **Alliance**
    3. **Product**

1. Vodafone launched a AI chatbot named TOBi. Users can download My Vodafone app or login to Vodafone’s website to use TOBi. TOBi is powered by IBM Watson and LivePerson, integrated with Amazon Alexa. TOBi can help deal with customer service issues such as phone maintenance, account usage queries, and order tracking, as well as improving the online customer service experience. Vodafone revealed that TOBi can achieve seamless handover with network service consultants. TOBi helps Vodafone to reduce the cost and improve customer service by shortening the questions’ responding time.
2. Vodafone launched a virtual agent “Hani” uses intelligent chatbot technology to better support and enhance consumer digital self-service. Hani answers 80,000 enquiries per month. The staffs in contact center use Hani to get accurate and up-to-date information of Vodafone products and services.
   * 1. **Standard**
     2. **Project**

According to Global Recruiting Trends, Vodafone uses artificial intelligence to interview more than 50,000 applicants for its call center and customer service jobs, starting with the video interview. After potential applicants recorded their video responses to standardized questions, "robots" (computers programmed with advanced algorithms) analyzed video based on 15,000 factors, these factors include body language, facial expressions, and tone of voice. If applicants pass the AI test, they will be invited to a real person interview. Vodafone said that after using this approach, the recruitment times have been cut in half, and hired people has better “attitude”, because the phone interview cannot always observe a person's attitude.

* 1. **Deutsche Telekom**

Deutsche Telekom is the largest telecom operator in Europe and the fifth largest in the world headquartered in Bonn Germany. “T” is the brand sign of Deutsche Telekom and other global subsidiaries such as the most famous one T-Mobile. T-system, the major service in the company, is world leading ICT solution and service provider.

According to DT’s website, “At Deutsche Telekom, development of AI systems is an important priority”. Since September 2016, Deutsche Telekom, in partnership with Amazon and using its AI assistant Alexa, has been providing voice capabilities for DT’s smart-home platform Qivicon. DT also launched Tinka chatbot for customer service queries two years ago. Recently, DT announced to launch its own AI assistants and AI-based speakers to control smart-home devices and services such as EntertainTV. It is enough to see that the company plans to accelerate its transition to AI.

* + 1. **Platform**

1. Deutsche Telekom launched Tinka, a chatbot acts like a virtual employee, aims to assist customers in Austria at any time of the day. Tinka is an icon of a young woman with long hair, she has learned over 1,500 answers and can solve 80% of problems. When she can’t handle the questions, she will forward it to a customer service agent. This is one of her strengths, to connect customers to customer service agents. If the agent is not available right now, she will recommend customers send emails to the agent.
2. Besides, the company owns other virtual assistants include Sophie, a chatbot supports service team of DT’s website; and Vanda, the invisible assistant for corporate customers. DT also launched a AI program named eLIZA to set up AI-based systems at various locations and different countries within Deutsche Telekom Group. The company also uses AI on protecting employee’s devices against cyberattacks. Mobile Protect Pro aims to protect networks, applications, Android and iOS devices through monitoring parameters and detects anomalies.
   * 1. **Alliance**
     2. **Product**
3. In November 2017, Deutsche Telekom announced to launch the Smart Speaker, an intelligent assistant, on the German market in the first half of 2018. Users can use the Smart Speaker on Magenta SmartHome applications in their homes, and make commands by saying the wake word “Hello Magenta”. Such commands can do the voice control of EntertainTV without using remote control to change channels and adjust volume, as well as adjusting the lightness of lights and room temperature. It can also play voicemail messages and put your phone calls on Smart Speaker by directly connecting with the user’s router rather than connecting to other devices. The Smart Speaker can access various of applications in Alexa, Amazon’s voice control tool by connecting to the Amazon system.
4. Deutsche Telekom unveiled an application names CONNECT to find the best available Internet connection. There are various of ways to connect to the Internet, 3G, 4G, hotspots or Wi-Fi with different price, thus, it is not easy for users to choose the best way of Internet connection. Although, some of users do not care the way to connect the Internet, the majority of users value price, network speed and security. Manually changing connection is inconvenient and is not always satisfied. The CONNECT app uses machine learning technology to help users choose between “Best connection” and “WiFi preferred”, as well as gives customers full control of high speed or cost. It provides fast access of Internet and high security of connections. An integrated VPN encryption enhance data privacy when users are using public Wi-Fi networks.
   * 1. **Standard**
     2. **Project**

Deutsche Telekom uses the hub: bot, a AI-supported chatbot designed by DT’s startup incubator Hub: raum, to improve job seekers’ experience and interview efficiency. The hub: bot answers applicants’ questions immediately and available 24/7. It saves applicants times on making appointments and waiting for the responds. The hub: bot also enhance the efficiency of recruiters for helping them weed out applicants who are completely unfit for the job or who are too kind to customers to waste resources. It allows recruiters just to focus on suitable applicants.

* 1. **Orange S.A.**

Orange S.A. is the subsidiary of France telecom headquartered in Paris. It is the first mobile operator in Britain and France, and one of the largest telecom operators in Europe. The main services for the company are mobile, landline, internet and IPTV services since 2006.

Not only the telecom operator Orange values the development of Artificial Intelligence, but also the French government believes it is crucial to explore AI. According to Orange’s official website “The French government recently launched France IA (for “Intelligence Artificielle”), an entire ecosystem mobilization plan so as to establish the country’s position on an issue with major stakes”. It is not to see that develop AI is a tendency, Orange has collaborated with other corporations to jointly develop AI.

* + 1. **Platform**
    2. **Alliance**

Orange and Deutsche Telekom, the leading operators of the two countries, announced a joint development of Djingo, a voice assistance platform based on Artificial Intelligence. The two companies have integrated all their algorithms and AI knowledge into Djingo. According to the design plan, Djingo can respond to voice and text messages sent by users, answer questions, send text messages, make phone calls, play music and video through Orange’s set-top-box, control smart home devices, tweets and so on. Users can send an “OK Djingo” command to the microphone to interact with it, or type an interactive command through a mobile app. Stephane Richard, Orange’s chief executive, showed a prototype Djingo that looked like a small speaker. He revealed that Djingo can be integrated into a variety of terminals, such as a TV remote control with a microphone. Users will be able to use the service through a smartphone application.

* + 1. **Product**
    2. **Standard**
    3. **Project**

* 1. **SK Telecom Co., Ltd.**

SK telecom is the largest mobile communication operator in South Korea, it is part of SK group, one of the largest chaebols in South Korea. SK is the world’s first corporation to commercialize CDMA technology and launched DMB satellite. The online brands for the company are “Nate”, “June”, and “Moneta”.

SK Telecom persists in the development strategy of new ICT industry centering on Artificial Intelligence. SK connects with AI and developing AI platform when developing all industries. SK build a new AI-centric ICT eco-environment in the SKT industry focusing on the Internet of vehicles, smart home, global content, media services and energy management.

* + 1. **Platform**

SK Telecom launched the world's first Korean digital service assistant "NUGU" Launched the world's first Korean digital service assistant "NUGU". NUGU uses voice recognition and natural language processing to help users control smart appliances, query information on the Internet, or play music. The implementation of NUGU covers three areas, automobile, family and mobile, which becomes the basis of the AI ecosystem

1. Automobile

Artificial intelligence vehicle navigation system “T MAP x NUGU” enables drivers to access existing navigation functions and real-time traffic information by voice, as well as using voice command to adjust the volume, command it to end the service and close the application, etc.

1. Family.

SK Telecom launched several products related to the family area which are NUGU, NUGU mini, BTV x NUGU. BTV x NUGU integrates IPTV set-top boxes and AI platform NUGU together, does the complex search through natural language, and controls other intelligent devices in home.

1. Mobile

In this area, SK Telecom mainly focusing on kid’s market. SK launched a kids’ watch JOON x NUGU, kids’ phone “mini phone x NUGU”. Major functions include location sharing, encyclopedia, Korean dictionary (education), weather, alarm clock, schedule, fortune-telling, and emotional dialogue.

* + 1. **Alliance**

Airtel collaborated with SK telecom to develop an artificial intelligence support network. SK telecom has deployed an artificial intelligence support network called TANGO with big data analytics and machine learning capabilities. It enhances the user experience by self-detecting the mobile network, troubleshooting and optimizing it.

* + 1. **Product**

1. On Mobile World Congress 2018, SK Telecom exhibited their technologies related to its congress’s theme of “Perfect 5G”, a hologram artificial intelligence, a 5G autonomous car and 3D HD maps. SK Telecom has just completed a drive trail of their 5G autonomous car recently. It uses 3D HD maps and V2X technology to find passengers and accidents on the road.
2. SK Telecom introduced Okususu Social VR that uses Samsung’s Gear VR and Google Daydream display on a 1080p TV screens to show its technology. Oksusu Social VR enables users to engage with video content and interact with other users within the virtual world. However, there is a difference between 4G speed of VR and 5G. With 4G version of Oksusu, users can watch and comments upon movies, video games, concerts and other amusement just like they are watching it on TV. While with 5G speed, Oksusu gives users an immersive experience. 5G version of Oksusu will possess 8K videos with 16 times as much as detail as the 4G version and the ability to stream live movies or concerts’ contents at various places, making users feel like they are watching a movie at a movie theater.
3. SK Telecom unveiled South Korea’s first AI Acceleration Solution names ‘AI Inference Accelerator’ or ‘AIX’. SK mentioned that AIX is a palm size, card-shaped accelerator that greatly accelerate the speed of AI computing, which increased five times capacity for AI acceleration, as well as offering customers higher quality of AI services. The company has applied AIX to ‘NUGU’, the world’s first Korean digital service assistant launched in 2016. Because NUGU has applied to many devices such as NUGU mini and Kids’ phone, 16 times better energy efficiency than before helps SK reduce the operating cost of data center infrastructure and give customers better usage experience.
   * 1. **Standard**
     2. **Project**
4. On February 2018, SK team up with Korea Transportation Safety Authority announced to deploy the world’s first 5G autonomous driving test city——5G infrastructure in K-City, South Korea’s pilot city for self-driving cars. It provides a place for organizations in South Korea to test and develop their 5G autonomous driving technology.
5. SK telecom has also revealed that it will partner with entertainment companies to launch the music platform App for artificial intelligence later this year. SK telecom said it would use a variety of technologies, including artificial intelligence, 5G and blockchain.
   1. **Singtel**

Singapore telecommunications limited, always abbreviated as Singtel, is the largest telecom operator in Singapore based on 640 million subscribers, and the second largest wireless network company. Singtel provides ISP service names “SingNet”, IPTV service names “Singtel TV”, mobile phone networks names “Singtel Mobile”, and fixed line telephony services.

Singapore National Research Foundation(NRF) announced to launch of a national Artificial Intelligence plan called AI.SG, aims to promote and enhance Singapore’s AI capabilities. AI.SG hopes to bind AI research institutions, start-ups and industry companies together to jointly increase knowledge base, develop advanced research tools, and foster scientific and technological talents to enhance Singapore’s AI capabilities. Singtel as the largest telecom operator in Singapore follows NRF’s AI plan to accelerate AI developments in Singapore and Asia.

* + 1. **Platform**
    2. **Alliance:**

1. SenseTime, an Artificial Intelligence leading company, signed memoranda of understanding (MOU) with Nanyang Technological University, National Supercomputing Center of Singapore, and Singtel on June 29, 2018. The collaboration aims to leverage each other’s strength and customer base to enhance AI research, accelerate digitalization for corporations, and exploit solutions based on Artificial Intelligence to suffice for the demand of industrials and organizations in Singapore and Asia. (Loong, 2018)
2. Singtel team up with Nanyang Technological University and Singapore’s National Research Foundation spent s $42.4 million (about $31.3 million dollars) to set up Singtel Cognitive and Artificial Intelligence Lab for Enterprises (SCALE) in 2017, focusing on Artificial Intelligence, Data Analysis and IoT. It will research and develop technology applications in the areas such as public safety, transportation, health care and manufacturing in the next five years. (Education, 2017)
3. Singtel also signed a five-year Master Research Collaboration Agreement with Singapore Agency for Science, Technology and Research. According to the agreement, both will work together to research and develop the smart building automation system, robot and IoT applications and other technologies. It will assist enterprises to face the difficulty of human resources shortage, and improve the operational efficiency of the industry. Singtel will also set NB-IoT and 5G network in Advanced Remanufacturing and Technology Center launched by Master Research Collaboration Agreement.
   * 1. **Product**
     2. **Standard**
     3. **Project**

One of the research project of SCALE is condition-based maintenance. The project uses the IoT sensors and Artificial Intelligence to predict when these facilities will need to be repaired before building facilities such as escalators or elevators fail. According to Singtel, the partnership will enable new telecom to collaborate with the government’s blueprint for industrial transformation in emerging technology, digital transformation and the vision of a smart country.

* 1. **Telefonica**

Telefonica is a Spanish telecom operator. Telefonica provides services include fix communication line, mobile phone, internet, data, cable TV and so on. Telefonica has considerable influence in countries that speak Spanish and Portugal.

Telefonica has increased its use of AI in its operations in recent years. Telefonica had previously launched service centers in several markets, the most meaningful change is the Artificial Intelligence. According to Telefonica, the traditional network operation center is managed and maintained by the network management personnel, while the service operation center mainly relies on computer analysis and AI to achieve automatic closed-loop maintenance. Applications based on AI will help Telefonica optimize the network, eliminate potential problems before they are discovered. The company's ultimate goal is to eliminate all potential problems through network automation

* + 1. **Platform**

On Mobile World Congress, Telefonica has launched Aura, a voice assistant for six countries, including Argentina, Brazil, Chile, Germany, Spain and the UK. Aura can interact with users through AI technology. In Argentina, Brazil and the UK, Aura will operate as a branded application; in Chile and Germany, users can use Aura on Messenger; in Spain, Aura will be on its own pay-tv platform. Telefonica announced that Aura will be integrated with Google’s assistant and Microsoft Cortana on 2019.

As mentioned before, Aura, Telefonica's AI and voice-controlled digital assistant, has been used on its pay-tv platform in Spain. This is the first time that Aura is integrated with television services. Aura will be applied to Movistar’s iOS and Android APP. This AI tool will allow users to talk to pay-tv platforms, find content, find recommendations and explore exciting shows. It will be the heart of MovistarHome, the home digital hub that will be released later this year.

* + 1. **Alliance**
    2. **Product**

Telefonica unveiled Smart Notifications, a proprietary patented technology that uses Machine Learning and Artificial Intelligence solution for mobile Apps, determine when users are most receptive to brand interactions and enable users to receive the optimized smartphone notifications. According to the investigate, more than 50% of users are tired of receiving smartphone notifications. They think constant smartphone notifications distract their attention and make them disable notifications even delete the apps. Smart Notifications select the most appropriate moment to send notifications when users are most receptive to brand interactions. It Increased participation in push activities and reduce the cost on sunk customers and customer retention. This is Telefonica’s first product aims to solve the problem of “Attention Economy”.

* + 1. **Standard**
    2. **Project**

Telefonica collaborated with Juniper Networks to develop Self-Driving Network. The collaboration aims to transform the network infrastructure provided by Telefonica into an automated network capable of automatic discovery, automatic analysis, automatic tuning and automatic correction, as well as improving speed and eliminating cyberattacks. The Self-Driving Network will use machine learning, artificial intelligence and control systems to ensure the operation. The goal is to accelerate business development and lower the operating cost while enhancing security and flexibility.

* 1. **América Móvil**

América Móvilis a Mexican telecom operator headquartered in Mexico. It is one of the largest corporations in the world and the fourth largest mobile network operator based on equity subscribers. Its major services are wireless network, landline, broadband accesses and payTV.

* 1. **Bharti Airtel**

Bharti Airtel limited, an Indian telecom services company, is the largest mobile network operator in India and the third largest in the world by the count of subscribers. The company provides GSM, 3G, 4G LTE and VoLTE mobile services, fixed line broadband and voice services. Bharti Airtel pays attention on developing mighty internal technology capabilities and completing the transformation to a major digital operator in India.

* + 1. **Platform**
    2. **Alliance**

Bharti Airtel announced a strategic partnership with Amdocs aims to introduce advanced technologies and practices to enhance the service experience of Airtel’s customers. Bharti Airtel’s MD and CEO (India and South Asia) Gopal Vittal claimed that “Amdocs’ sharp focus on telecoms and their DNA of cutting edge innovation will add immense value to Airtel’s digital transformation journey and help us to world class experience to our customers” (Sahoo, 2017). Amdocs will apply machine learning and advanced AI technology to Airtel’s multiple lines of services and bring intelligent robot into digital channels. It helps Airtel pre-empt and self-heal operational problems, as well as quickly launch and activate new services to achieve seamless customer experience.

* + 1. **Product**
    2. **Standard**
    3. **Project**

Bharti Airtel launched “Project Next” to help the company transform to a digital operator. “Project Next” will invest 20 billion rupees (1.95 billion RMB) over the next three years. The company announced that it will set up the digital innovation laboratory, the research of AI, IoT, augmented reality and other innovative technologies, which is a part of “Next Project”.

Bharti Airtel set up a digital innovation lab in Bengaluru to develop technologies consist of AI, IoT, Augmented Reality and Virtual Reality. Airtel’s Global CIO Harmeen Mehta will lead the digital lab project. Although Airtel has a 550-people internal engineering and development team mainly focus on launching digital platforms, the company is hiring talented people for its digital lab project. The company will seek talents mainly in Bengaluru, India’s IT capital, some famous engineering colleges in India, talent from Silicon Valley, and cooperate with some tech start-ups to develop solutions. (Airtel Plans an Innovation Lab in Bengaluru to Develop AI, IoT Products, 2018)

* 1. **Telenor**

Telenor

* 1. **MTN Group**

MTN Group

* 1. **VEON**

VEON

1. **Major Concern**
   1. **Constructing AI Platform is Significant for Telecom Operators (IoT)**

Constructing AI platform is significant for telecom operators who are developing Artificial Intelligence. In the platform construction, technologies such as the IoT, big data and cloud computing are applied to the artificial intelligence platform to provide scene intelligent services according to different usage requirements. The Internet of things is particularly important. The raw material of AI is data, the main source of data is the Internet of things. If telecom operators want to build AI system, they first need to build IoT platform as data source. Verizon built the "ThingSpace" IoT platform and then combined it with AI to launch a series of smart services, including smart street lighting, smart monitoring and smart management.

To expand the development space of artificial intelligence, artificial intelligence technology is introduced into the vertical fields such as medical treatment, agriculture and sharing economy, so as to expand the application field of artificial intelligence. For example, NTT DoCoMo’s AI cloud platform “Corevo”; Orange and Deutsche Telekom jointly launched the voice assistant platform “Djingo”; China Mobile’s AI platform “JiuTian” and China Telecom’s AI capacity open platform “DengTa”.

* 1. **The Era of 5G Network is Coming (autonomous driving)**

As the communication network is evolving towards 5G, NFV, SDN, artificial intelligence will be an important enabling technology for the next generation network. As the top priority of operator construction and development in the next few years, 5G network naturally needs AI. 5G network will face differentiated access, networking and application requirements in the future, which is difficult to meet the needs of future network development only by manual work. At the same time, network reconstruction and network cloud also provide convenient for the introduction of AI. On MWC 2018, SK Telecom’s congress theme is “Perfect 5G” and introduced Okususu Social VR that need 5G network support. It is obviously to see that develop 5G network is the major task in SK Telecom.

To give users a better business experience, 5G network will be more closely integrated with applications and Cloud. 5G network needs to respond to changes of users and applications in real time, adjust network functions, topology and route, as well as adjust the flow of business in real time. Autonomous driving is a typical application of AI and 5G. As the vehicle moves, the vehicle will move from a service area in an edge data center to another edge data’s control area. To ensure the consecutive services, the core network needs to coordinate with terminals and applications quickly and automatically to ensure that data is not lost during high-speed movement. In addition, 5G's core network capabilities can provide intelligent scheduling, open edge platform capabilities, and rapid application deployment. Recently, China Mobile, China Unicom and China Telecom are conducting 5G autonomous driving tests, seeking technical solutions for C-V2X for remote control driving, multi-vehicle and autonomous driving. SK Telecom exhibited its 5G autonomous car on MWC2018 and deployed the world’s first 5G autonomous driving test city on February 2018. According to the statistics, Asia will lead the development of 5G technology in 2015.

* 1. **Telecom Operators’ Core Competence — Customer Service**

Telecom operators should pay special attention to customer service because it accounts for a considerable proportion in the operation of telecom operators. Telecom operators provide customers with customer service hotline, online service hall, mobile phone applications and other service channels to meet customers’ different usage customs. After operators enter the stage of full-service competition, the competition of service quality is increasingly critical. To improve user perception and reduce labor costs, it is particularly important for telecom operators to apply artificial intelligence to customer service platforms. Many telecom operators use AI chatbots and AI virtual assistant to help them suffice for their customers.

* 1. **AI Virtual Assistant Provides Higher Quality of Customer Service**

Many operators have already launched customer service robots based on text recognition, such as China Unicom’s intelligent robot “Wobao”, China Telecom’s intelligent customer service robot “Xiaozhi”, Vodafone’s virtual agent “TOBi” and “Hani”. However, the lack of intelligence has prompted operations to upgrade their original customer service robots to smart voice assistants. Deutsche Telekom launched several chatbots in the past few years includes “Tinka”, “Sophie”, “Vanda” and so on to improve the quality of customer service. The company is now preparing to enter smart homes with voice intelligence assistant called Magenta. In addition, other telecom operators also launched AI virtual assistants such as Orange’s Djingo, Telefonica’s Aura, and SK Telecom’s NUGU. These kind of intelligent voice assistants are more advanced than the previous text customer service robot, which is no longer limited to the existing business customer service support, instead of covering all kinds of ecological services. The intelligent voice assistant is a further upgrade to the existing virtual assistant of the operator. AI virtual assistant is closely related to operators' existing business, such as smart home and customer service. Entering AI virtual assistant market is crucial for the future business of telecom operators.

* 1. **Constructing Smart City is the Future Trendy**

Nowadays, emerging technologies has brought great changes to the development of city. With the help of a new generation cutting edge technologies such as artificial intelligence, IoT, big data, cloud computing and so on, integrating the core systems of city operations, including people, commerce, transportation, communications, water and energy. Operating in a smarter way to create a better city life. Currently, countries around the world are doing the attempts and practices on smart city. As a city’s leading power, telecom operators should seize the opportunity of development to play a major role in constructing smart city.

The function of smart city is to extend the communication between people to the communication between things. It is usually divided to four layers consist of application layer, platform layer, network layer and perception layer. The basic network of operators is a solid foundation for the development of smart cities. The big three telecom operators in China, China Mobile, China Unicom, and China Telecom, are dedicating to develop the construction of smart cities. Especially paying attention to the Xiongan digital project. AT&T collaborated with other companies to set up a new smart cities framework to help cities better serve their citizens and building more connected communities. In addition, NTT Group partnered with Dell technologies to development the smart city initiative.

* 1. **Collaboration is the Key to Better Research and Develop Artificial Intelligence**

Although, telecom operators have direct contact with users and have large user data to better understand customers’ demands, telecom operators have disadvantages on technical aspect. Collaborating and Alliancing with other Internet companies, AI technology companies, and telecom operators is the key to solve the problem, and almost all major telecom operators did so.

1. Telecom operators collaborate with Internet companies:

China Unicom cooperated with Tencent to launch cloud solutions for medical image application scenarios. Vodafone cooperated with Amazon to integrate its AI chatbot TOBi with Amazon’s Alexa. Amazon’s Alexa help Deutsche Telekom provide voice capabilities to DT’s smart home platform “Qivicon” and intelligent assistant “Meganta”.

1. Telecom operators collaborate with AI technology companies:

AT&T collaborated with IBM on the design, development, and deployment of all-new microservices supplier program. Softbank and SK Telecom are both working with IBM, the cognitive computing capacity of IBM "Watson" builds the processing capacity of natural language, which build the language communication skills of Softbank's pepper and SK Telecom's NUGU. Vodafone’s AI chatbot TOBi is powered by IBM Watson and LivePerson, integrated with Amazon Alexa. Singtel signed a MOU with SenseTime to enhance AI research.

1. Alliance between telecom operators:

Orange and Deutsche Telekom jointly develop the voice assistance platform names Djingo. Bharti Airtel collaborated with SK telecom to develop an artificial intelligence support network. Some alliances made by each telecom operators such as “ohrand” and “AIIA” to enhance the research and development of artificial intelligence.

1. **Recommendations for China Unicom**