

ZTE 5G Messaging Technical White Paper



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1 5G Serves the Public and Various Industries

2019 is the first year of 5G commercial use, and 5G began to develop in a large scale and enter the fast track to accelerate development in 2020. According to the latest statistics of GSA, 101 telcos in 44 countries and regions had launched 5G services by mid-September 2020. By the end of September 2020, 690,000 5G base stations had been built in China, with more than 160 million 5G terminals.

The purpose and goal of 5G development is to serve the public and thousands of industries. After the development of 5G networks and terminals has entered the fast lane, they face the following problems: Firstly, what kinds of new businesses, new experience, and new services are brought to the public? What do 5G users use? What killer services are there for 5G? Secondly, what are the 5G business model and profit model?

At present, the commercial development of 5G is accelerating. ToC services are advancing steadily, providing 5G network access and traffic services for users. Applications in the ToB market are being actively explored, but still there is a certain distance to go before they can be launched and replicated for promotion. For the IoT, though the number of terminals and connections has increased rapidly, the APPU value is too low, and it is not easy to use and lacks of application. 5G technologies and products need to continuously grow up and be more mature in practice.

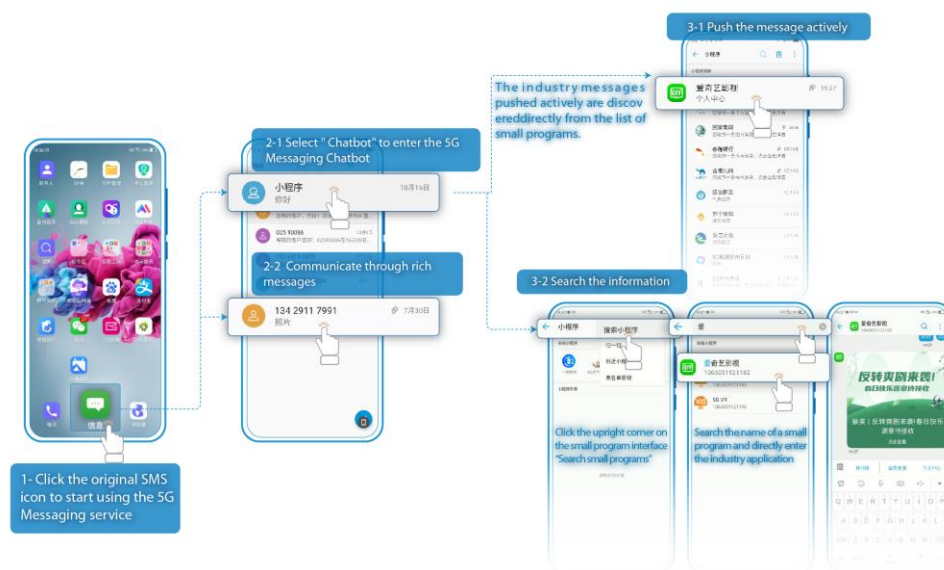
Mobile communication is upgraded to 5G to support ultra-high bandwidth (eMBB), ultra-low latency (uRLLC) and massive IoT connections (mMTC) scenarios and ultra-high reliability. Based on new network technologies, new features, and new capabilities, the 28-year-old SMS is upgraded from basic communications to 5G Messaging, providing Rich Messaging transfer, applications, and services between "people" and "people", "people" and "things", and "things" and "things", and providing more technical capabilities based on AI, big data, cloud, payment and location. 5G Messaging will bring brand-new service experience and digital services to public users, thousands of industries, and massive IoT terminals.

5G will not only further change life, but also bring about profound social changes and industrial changes on the Internet of Everything. The upgraded 5G Messaging brings new digitized and service-based communication features. It provides the most popular and basic

ToC services for the public. Meanwhile, it may be the first launched 5G ToB service and ToB business model, to open a brand new door to the ToT (To IoT) market for massive IoT messages and applications.

2 5G Messaging Entrance

The message service is the basic service and entrance of telecom network. In the 5G era, as SMS is upgraded to 5G Messaging, the service entrance and use are as follows:



G

Messaging Service Entrance

Step 1. Click the original SMS icon to start using the 5G Messaging service.

Step 2: In the 5G Messaging service interface, select "Chatbot" as Step 2-1 to enter the 5G Messaging Chatbot. In Step 2-2, select the personal rich messaging function history information, and you can, based on the user number, receive and send multimedia instant messages, without the need to add a friend.

Step 3: In the interface of 5G Messaging Chatbot, there are two ways to use: In Step 3-1, the industry merchant sends messages and Chatbots to the user through the notification, and the user can start to use industry Chatbots directly based on the notification, such as daily electricity fee and call fee query and payment. In step 3-2, you can search for the industry service to be used through the keyword, such as ticket purchase and e-shopping.

The 5G Messaging Chatbots used by the user can be found and used directly through the history list on the Chatbot interface.

The 5G Messaging service entrance has the following features:

Reserving features and advantages of SMS: Based on the original SMS entrance, and the authentication of the phone number and operator network, with no need of installation and registration, 5G Messaging services can be entered directly, which provides telecom attributes including 100% coverage, 100% reach and real-name security.

Making upgrade and comprehensive innovation of capabilities: 5G Messaging can not only provide images, audio and video, location, card, and other multimedia contents, but also support Chatbot search, menu, dialog, payment, built-in Web page, and other one-stop capabilities. It is the entrance to new multimedia contents and information services, and considered as a revolutionary and disruptive upgrade.

Making new message communication of massive IoT terminals: 5G Messaging defines and supplements message communication protocols and standard gaps for IoT terminals. Based on the definition of 5G IoT Messaging, IoT terminals support new capabilities and new features such as message sending and receiving and message applications. The message communication and connection between IoT terminals and people/applications are more convenient and faster, and the application value of massive IoT terminals is greatly increased.

3 5G Messaging Definition

Based on the 5G network and technology evolution, standard development, and service and terminal development, 5G Messaging is divided into three major messaging service and function categories:

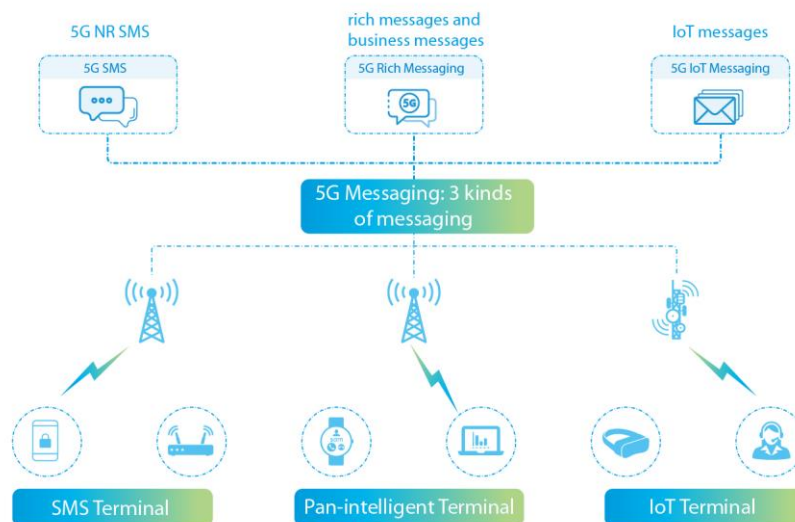


Figure 3-1 5G Messaging Definition

1. 5G SMS

In accordance with 3GPP technical standards and terminal capabilities, 5G networks and terminals continue to support the 5G NR-based SMS functions, that is, SMS over NAS (NAS, Non-Access-Stratum, 5G terminal accessing 5G system protocol). SMS continues to exist and provide SMS capabilities. Its service functions and experience are exactly the same as those of traditional SMS, supporting 140-byte text short messages.

2. 5G Rich Messaging

For a long time, the functions and experience of traditional text messages restrict the development of the message service, lag in meeting the growing requirements of public users, and hinder the development of industrial applications and their commercial value. In the 5G era, short messages are upgraded to rich message-based services to achieve an all-round upgrade of functions, businesses, experience, and services.

- i. Personal Rich Messaging: Public user messages, including one-to-one personal instant rich messages; supporting text, picture, audio and video, location, emotion, card, and other media contents; and supporting group management, group chat and group messaging.

- ii. Industry Rich Messaging: Upgraded industry SMS, supporting industry rich messages, card messages, and Chatbot interactive conversation messages.

Industry Rich Messaging is displayed and used on the terminal through Chatbots (the commonly known name and entrance of Chatbot on the native terminal) to implement Message as a Service (MaaS) and Message as an Application (MaaS).

2. 5G IoT Messaging

The connection to massive IoT terminals is realized through 5G IoT Messaging standards and technologies that feature in massive connections, low bandwidth, and lightweight:

- i. Message communication between "things" and "things"
- ii. Message communication between "things" and "people"
- iii. Message communication between "applications" and "things"

5G IoT Messaging implements real message communication and interconnection of everything.

5G SMS, 5G Rich Messaging, and 5G IoT Messaging jointly build and comprise complete 5G Messaging technologies and services to meet the requirements of all types of terminals in 5G networks for message service functions and applications.

4 5G Messaging Service

5G Messaging serves massive public users and thousands of industries. In addition to ToC and ToB services, it also provides IoT-oriented services and applications (referred to as ToT for short), that is, it provides services for massive interconnected things and various industries.

ToT includes ToH (Home, home IoT terminals).

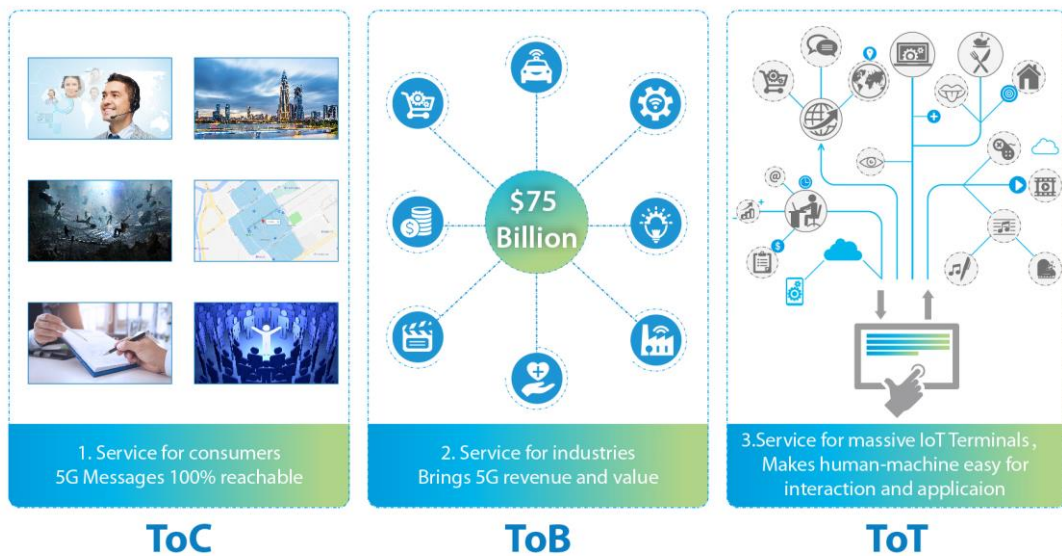


Figure 4-1 5G Messaging Service Range

4.1 ToC

ToC (To Consumer) provides 5G Messaging services for all individual consumers, including:

1. 5G SMS, providing point-to-point SMS function and service experience which are exactly the same as those of 2G SMS.
2. 5G Rich Messaging services, including:
 - i. One-to-one instant message, supporting text, image, audio and video, file, location, emoji, card, status report, and SMS fallback.
 - ii. Group management, group chat, and group messaging

In terms of terminal experience, the SMS and 5G Rich Messaging inboxes are integrated. The box shows the differences based on network and service attributes and whether they fall back.

4.2 ToB

ToB (To Business) provides business messaging services or applications for enterprises, industries and government agencies, including:

1. B2C service
 - i. Industry SMS: The functions and service experience of 5G Industry SMS are exactly the same as those of traditional industry SMS.
 - ii. Industry Rich Messaging: It supports industry rich messages oriented to third parties such as industries, enterprises, government and public agencies and provides industry template messages, card messages, and Chatbot applications through Chatbots.

With the support of business media industry messages and the 5G Chatbot entrance native terminals, Messages as a Platform (MaaP), Message as a Service (MaaS), and Message as an Application (MaaA) can be implemented.

2. B2B service

Based on the 5G Rich Messaging function and service capability, the B2B service can be provided. For example, Chatbot applications can be used to provide such services as enterprise OA, conference reservation and audio/video conference access, meeting business requirements of enterprises.

4.3 ToT

5G ToT (To IoT) Messaging provides message services and applications for massive IoT terminals, including:

- i. IoT terminal point-to-point service: Based on the 5G IoT Messaging technology, it supports direct message communication between IoT terminals, that is, IoT Messaging communication.

- ii. IoT terminal group and broadcast message service: Based on the 5G IoT Messaging technology, it supports to establish IoT terminal groups and chat groups, and send broadcast messages.
- iii. Application-to-IoT-terminal service: Based on IoT Messaging standards and technologies, the application message service from applications to IoT terminals is also known as IoT Industry Messaging.
- iv. People-to-IoT-terminal service: Based on IoT Messaging standards and technologies, and the human-machine interaction platform (gateway), 5G Messaging can support message communication, presentation, and control between people and IoT terminals, making IoT terminals and applications easier to use and more popular.

5G Messaging supports establishing group-to-group chat services between people and IoT terminals.

4.4 Vision

5G Messaging is transformed by 5G technology innovation and network upgrade and reconstruction to create native information entrances and digital services for telecommunications services. It reflects the service essence and aspirations of the telecommunications industry. The vision and goal of 5G Messaging service development is to create a unified digital entrance for telecommunications services and provide unified services. 5G Messaging terminals can serve the public, thousands of industries and even everything in a unified way:

1. Personal entrance: Create the first entrance to digital information services for public users. The terminal card can be plug-and-play to provide the most convenient, rapid, and secure information communication services. The number-based Instant Rich Messaging service supports flexible message sending and receiving and group messaging. It provides the first entrance and selection for communication. It trains users to use the 5G Messaging service as a communication tool for daily life and work, and returns to the essence of communication services.

2. Enterprise entrance: It is the best choice to construct the enterprise information service entrance and enterprise traffic. It serves as a bridge connecting the vast number of consumer users and industries, and helps enterprises directly push contents, information and services to users. Users can search and obtain enterprise services on demand through the 5G Messaging Chatbot. Providing the most direct and fast services to users, it becomes the first choice of enterprise industry application traffic.
3. Entrance to everything: It is the optimal choice to create the information service of everything and human-machine interaction. The 5G Messaging entrance of intelligent terminals can be used to send or receive messages to IoT terminals. Connections to IoT terminals can be established through searching IoT Chatbots and the telecom network will ensure the authentication and security.

Messages connecting everything, big messaging can be connected to Internet of Things (IoT). Through human-machine interaction, the IoT can be connected to the Internet of People (IoP), making IoT easy to use, reliable, and secure.

5 Terminal

As shown in Figure 1, 5G Messaging provides 5G Messaging services based on the message (SMS) entrance of the native terminal.

5G Messaging cannot be downloaded as an APP or registered to use services.

5G terminals include but are not limited to 5G pan-intelligent terminals (cellular network-based smart phones / tablets / PCs), 5G data cards, CPEs and IoT terminals. 5G Messaging is oriented to full-type terminals and provides 5G Messaging businesses and services. For old terminals that do not have 5G Messaging capabilities, the network side, terminal side and application side can provide corresponding message fallback to ensure that the message can definitely reach the user.

5.1 Native Terminal

1. 5G SMS terminal

- i. 5G pan-intelligent terminals: All the intelligent terminals, based on the phone number and SIM card, providing SMS based on the 5G NR access network and SMS over NAS.
- ii. 5G data cards: Data card terminals providing SMS based on the 5G NR access network and SMS over NAS.
- iii. IoT terminals supporting the 5G NR access network and SMS over NAS to provide SMS

2. 5G Rich Messaging terminal

Telcos are listing GSMA RCS UP as the mandatory support of terminals and terminal specifications:

- i. GSMA has officially released the NG 114 specification document in August 2020, specifying that Rich Messaging is a mandatory capability and support for 5G terminals.
- ii. The industry standards of the People's Republic of China were approved at Dec.2020 to formulate technical requirements and relevant specifications for 5G Messaging terminals. Gradually, 5G Rich Messaging will be the mandatory capability and support of intelligent terminals.



In addition, according to terminal vendors' support for terminals and firmware capabilities, some newer 4G smart terminals can support or upgrade to support 5G Rich Messaging.

3. 5G IoT terminal

As the 3GPP 5G IoT message standard is gradually completed and frozen, NB-IoT terminals and eMTC terminals are developing towards supporting technical standards and capability transition of 5G IoT Messaging. In the future, IoT terminal technical requirements and specifications of telcos and requirements and specifications of industry standards for terminals will be formed.

5.2 SDK

Terminal vendors can develop their own SDKs or cooperate with professional SDK vendors (OEM), and then support native 5G Messaging services of native terminals through UI development (smart terminals).

In the early stage of the development of new services, to reduce the difficulty and threshold of native terminal support, telcos can provide SDKs for terminal vendors through SDK open sources or open source organizations, thus accelerating the maturity and popularity of the terminal industry chain.

Terminal SDKs or terminals require unified specifications, update mechanisms, and network access quality control from telcos to ensure service quality and user experience consistency.

SDK usually needs to be upgraded and updated along with the update phase of the latest standard. The terminal vendor can upgrade or renew it with the terminal model or F-OTA (Firmware Over The Air).

6 Network and Architecture

6.1 Network Support

5G Messaging is based on 5G network and IoT network. In this file, IoT refers to the eMTC and NB-IoT cellular IoT network technologies and standards that support massive connections.

5G Rich Messaging can be compatible with 4G network access. For example, when a user is handed over from a non-5G network to a 4G data network, the 5G Rich Messaging terminals and services can be connected and used normally.

The network side supports terminal interoperability and downward compatibility in non-cellular network coverage areas and 2G/3G/4G networks.

6.2 Network Architecture

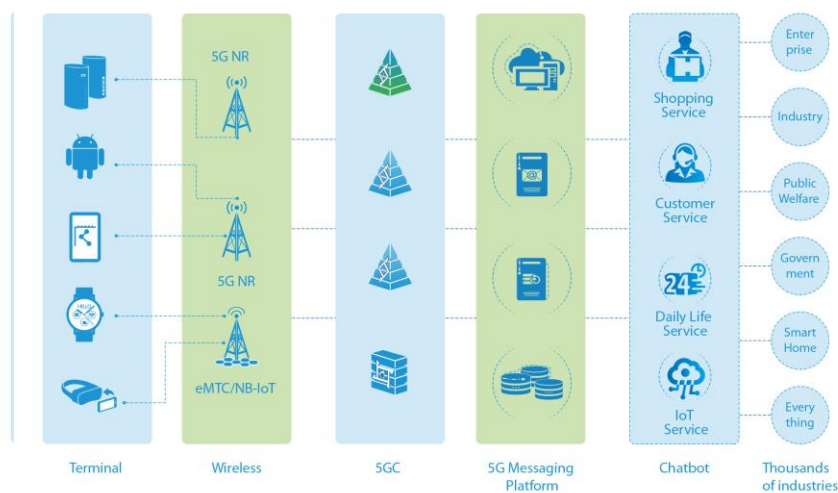


Figure 6-1 Overall Network Architecture of 5G Messaging

The above figure shows the 5G Messaging network architecture. Terminals access the 5G Messaging platform through the 5G NR wireless network, NB-IoT or eMTC network. They are connected to the 5G core network for processing and bearing to provide three types of message services and business services for 5G terminals.

The 5G Messaging platform is a core capability platform that provides the access, processing, storage and forwarding of 5G Messaging terminals, and sends and receives end-to-end messages.

The 5G Messaging platform includes NFs such as access module, configuration module, message AS, MaaP and file transfer service. The MaaP and its open API support access of third-party Chatbots and provide applications and services. They are the platform and channel connecting enterprise services (ToB).

Based on the above network architecture, massive IoT terminals can support message communication between things and things or between things and people, or be integrated based on Chatbots.

7 Standard

As a standard 5G technology and telecommunication service, 5G Messaging mainly follows the communication and message technical standards and specifications defined by three international standard organizations 3GPP, GSMA and OMA, to solve the problems of compatibility, interoperability and exposure between terminals, networks and platforms across vendors and telcos.

1. 5G SMS standard: 5G Messaging complies with 3GPP (TS 23.501, TS23.502) R15 5G architecture definitions, and is released and frozen together with R16.
2. 5G Rich Messaging standard:
 - i. 5G Rich Messaging is compliant with the standard GSMA RCC.71 v2.4, which is RCS Universal Profile Service Definition Document Version 2.4, namely RCS UP (Universal Profile) 2.4. It is updated to v2.5 that is mainly used to maintain the version and fix problems, and whose features are the same as those of v2.4.
 - ii. 5G Rich Messaging is compliant with the standard GSMA RCC.07 v11.0 Rich Communication Suite - Advanced Communications Services and Client Specification Version 11.0
 - iii. In addition, 5G Rich Messaging complies with supporting specifications for rich messages such as GSMA RCC.08, GSMA RCC.11, GSMA RCC.14, GSMA RCC.15 and GSMA RCC.72, which specify matching specifications such as configuration, interconnection, terminal, and error correction.
 - iv. 5G Rich Messaging is compliant with the standard OMA CPM - Converged IP Messaging Architecture 2.2
3. 5G IoT Messaging standard: It is based on the 3GPP R16 standard (TS22.262) and developed with the R17. It is expected to freeze and release the standard at the R17.

In China, 5G Messaging complies with the 5G Messaging industry standards formulated by the Ministry of Industry and Information Technology (MIIT) of China and the enterprise standards and specifications related to 5G Messaging of the three major telcos in China.

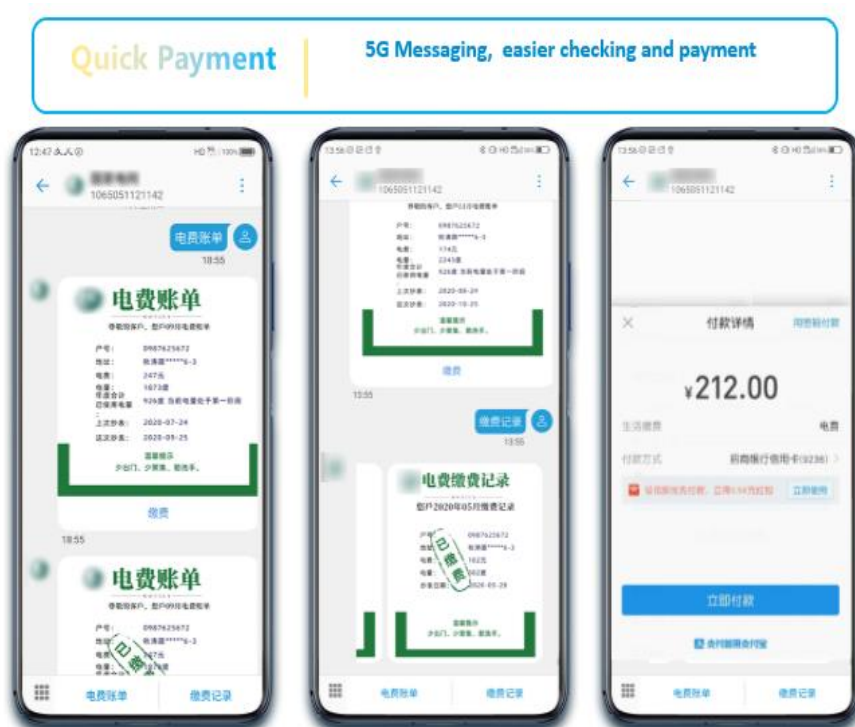
8 Typical Application Scenarios

5G Messaging not only supports rich messages through SMS upgrade, but also provides MaaP, MaaS, and MaaA through Chatbots to serve the public, thousands of industries, and even everything. Typical industry application practices and cases are described as follows.

8.1 Livelihood services

Typical Livelihood services are applied, such as water, power, coal, and government public services. The service of electricity fee checking and payment is used as an example.

- Power

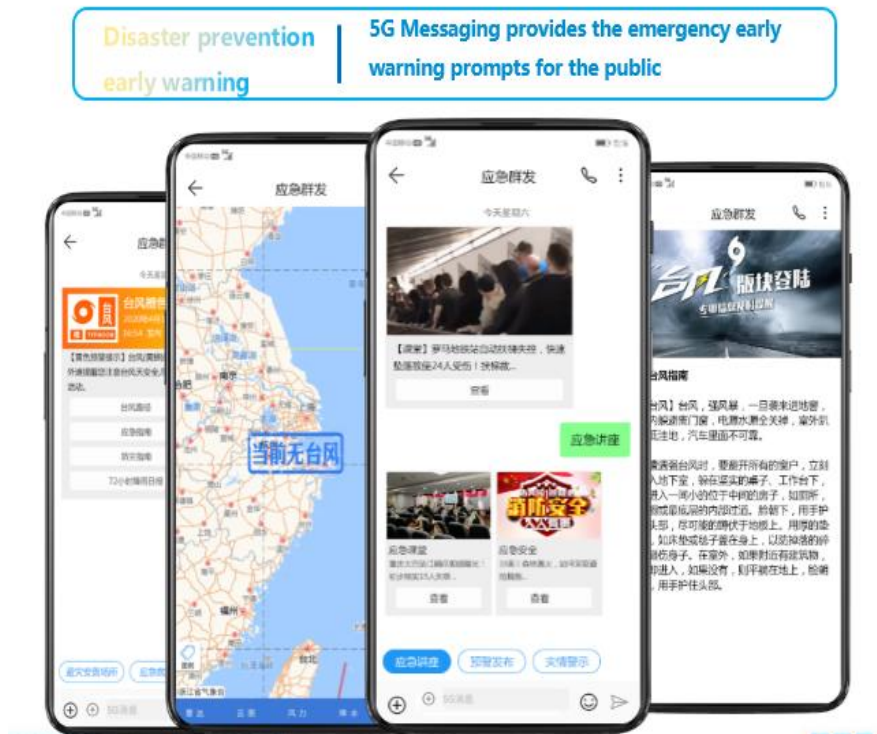


Scenario purpose: The service company regularly sends monthly 5G rich messages to household numbers, and delivers electricity bills of the current month, rapid one-click electricity bill payment (supporting various payment interfaces such as Alipay and UnionPay), payment record query, and history bill query. The service company can also push the latest industry news, and implement other life services through message interaction.

Function description:

1. Electricity bill query
2. One-click payment

3. Payment record query
4. News viewing
- Disaster prevention and alarm early-warning



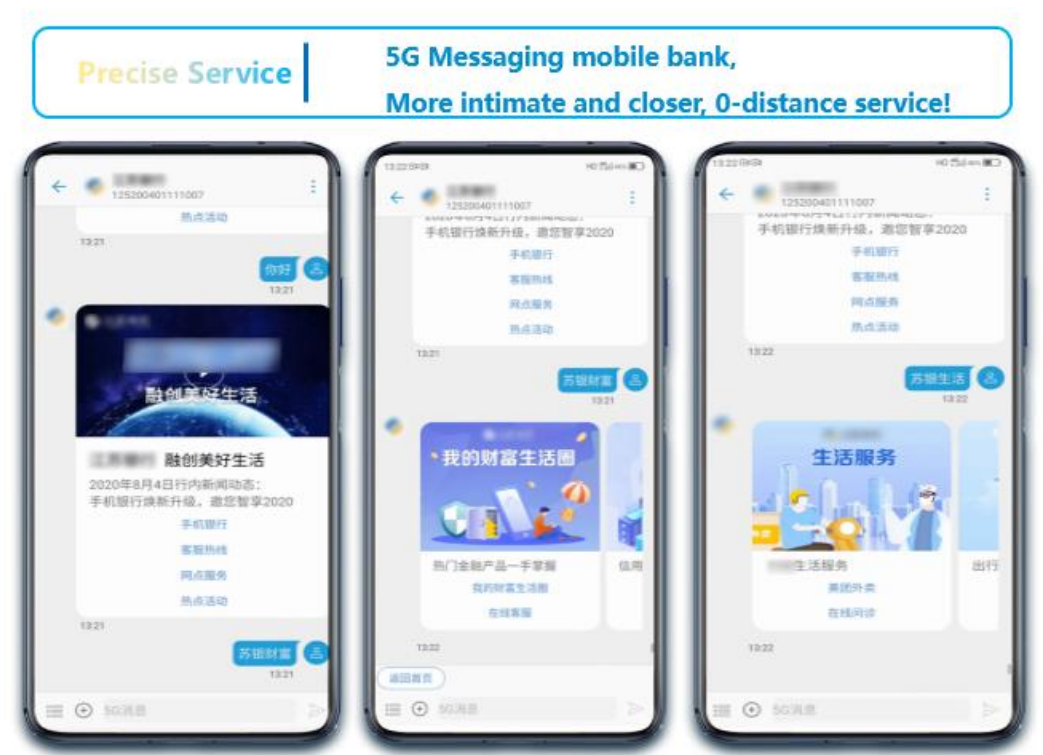
Scenario purpose: As an important public welfare and governmental public service, the emergency group messaging service can act as an intelligent early-warning assistant to the public. It provides the emergency group messaging, emergency reports, and help information and commanding system for disaster prevention, disaster reduction, and anti-typhoon/flood. It also pushes the typhoon early-warning information and science popularization information.

Function description:

1. Typhoon warning
2. Meteorological emergency
3. Tips for entering the plum rain season
4. Popularization of science

8.2 Financing

Financial services include banking, insurance, and securities. For example, 5G Messaging can provide the following typical services and applications for banks.

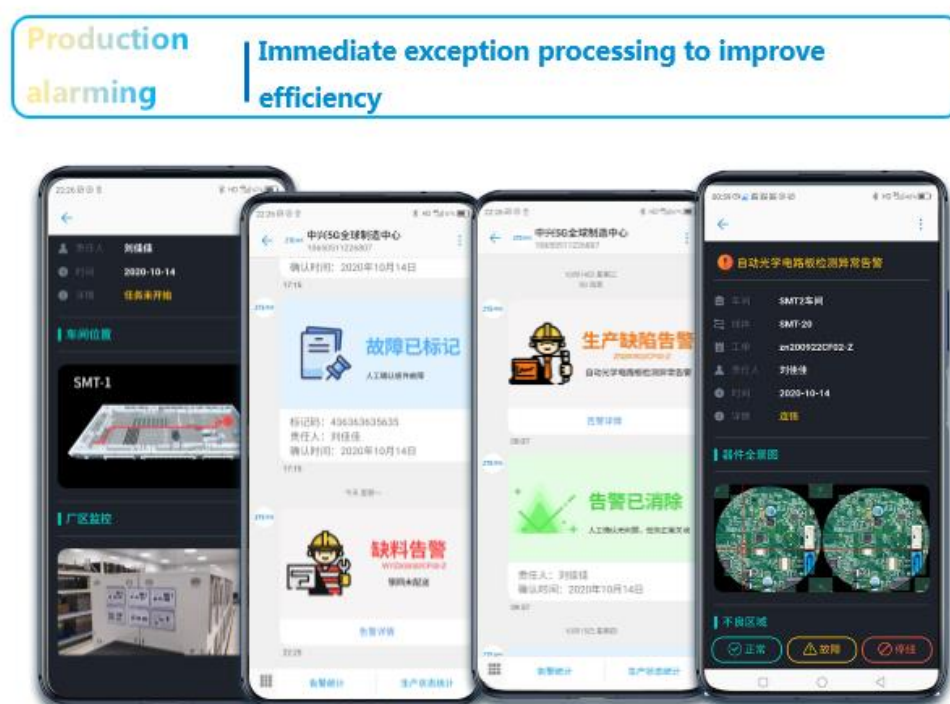


Scenario purpose: Through the strong interactive capability of 5G Rich Messaging, banks can improve the online transaction processing effect of credit cards together with marketing activities, forming a closed loop of online service processing scenarios such as 5G Messaging credit card, financing, personal or enterprise loan.

Function description:

1. Personal loan and enterprise loan
2. Financial recommendation
3. Enterprise loan
4. Credit card application and progress query

8.3 Industrial Manufacturing



Scenario purpose: Based on its own 5G communication technology, ZTE 5G Manufacturing Center employs 5G Messaging, together with the industrial internet of ZTE's Nanjing Binjiang 5G Intelligent Manufacturing Base, to accelerate the transformation of the manufacturing industry from the traditional partial IT-based manufacturing to the fully digitized, internet-based, and intelligent manufacturing.

Function description:

1. Real-time production fault alarming
2. Alarm statistics
3. Production status statistics
4. Production process processing

8.4 Education

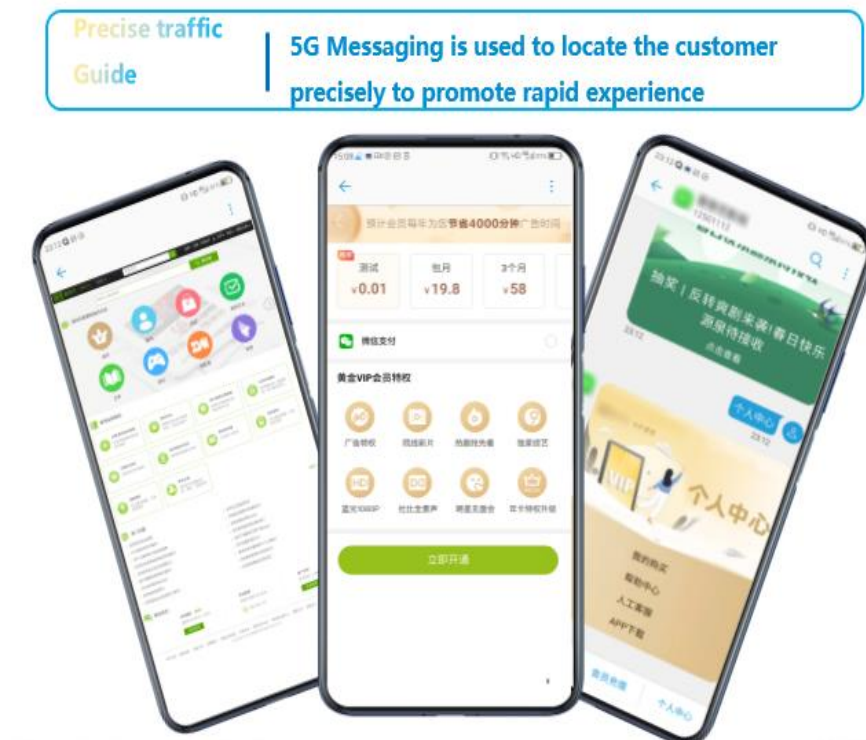


Scenario purpose: You can push a full series of online education services such as course consultation, course subscription, course audition, course learning, and course test on the education platform through 5G Rich Messaging.

Function description:

1. Course audition
2. Course subscription
3. Subject resources
4. E-certificate reservation
5. Health reporting

8.5 Entertainment



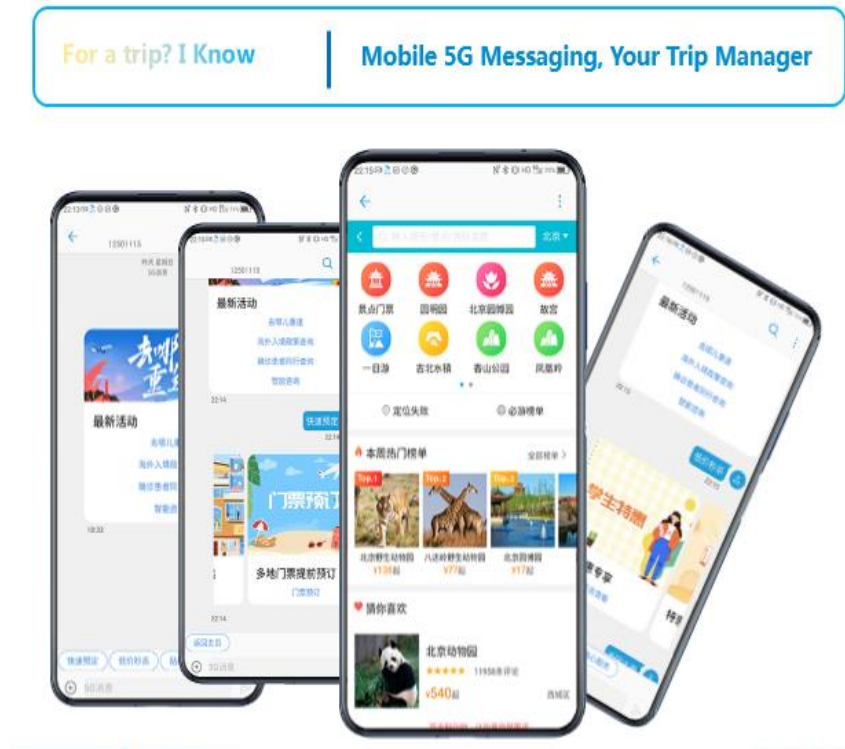
Scenario purpose: You can precisely locate and push messages to customers through 5G Rich Messaging. You can also obtain the movies, TV, and entertainment that you want to watch at any time through keyword dialogs. In addition, member services can be provided. This greatly improves the fast service and the video and entertainment service experience.

Function description:

1. Hot TV series
2. High-score movies
3. Latest variety shows
4. Ranking
5. Member recharging

6. Personal center

8.6 Business Trip



Scenario purpose:

Through 5G Rich Messaging, you can push travel information and service robot dialogs to rapidly realize travel services such as online booking and personal services.

Function description:

1. Quick reservation: air tickets, train tickets, bus tickets, hotel reservation, and travel tickets
2. Low-priced subscription: special offer for students, air ticket special offer, hotel special offer, and package for new subscribers
3. Heart-to-heart service: personal center, tourism strategy, and exclusive service

8.7 Mass Media

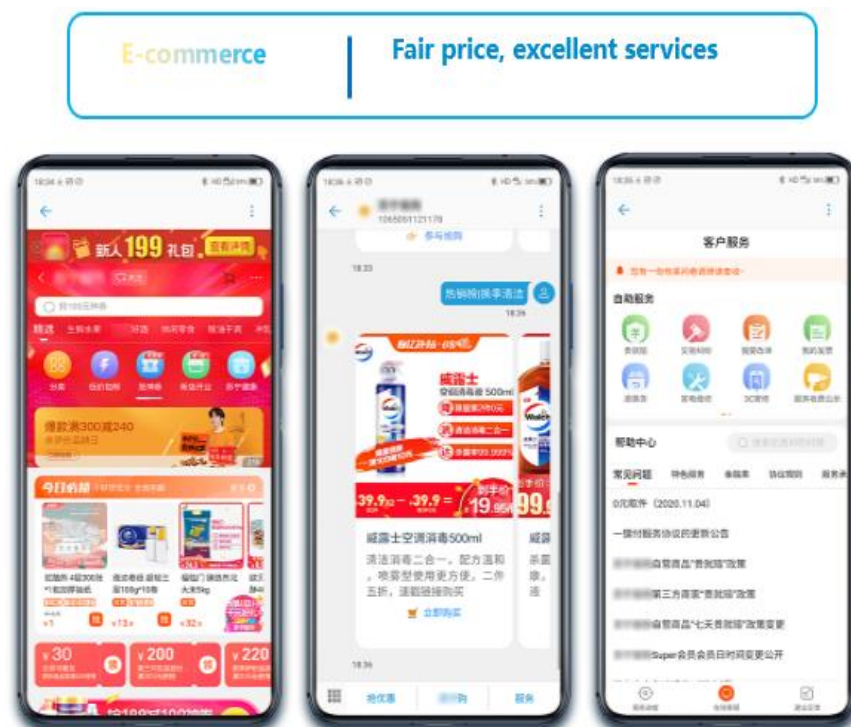


Scenario purpose: You can subscribe to and customize the latest news and hot search through 5G Rich Messaging.

Function description:

1. Daily report query
2. My subscription
3. Special recommendation
4. Hot search

8.8 E-commerce



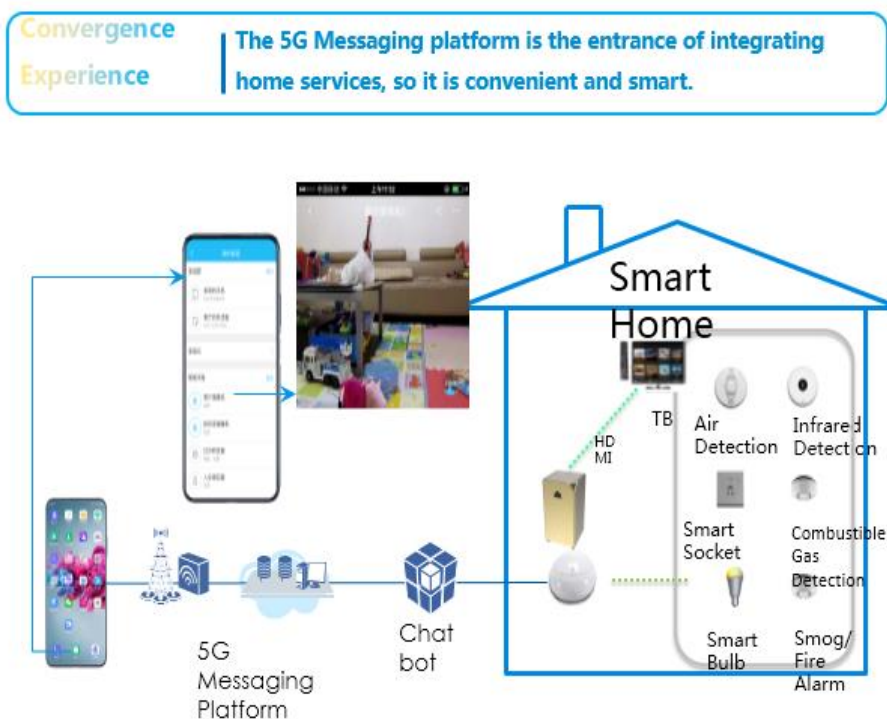
Scenario purpose:

E-commerce 5G Messaging: You can provide integrated shopping malls on the 5G Messaging platform, and provide convenient and safe shopping services in accordance with the existing promotion channels of E-commerce.

Function description:

1. Discount
2. Instant purchase
3. Order service
4. After-sales service

8.9 Smart Home



Scenario purpose:

Smart home is one of the typical ToT applications of 5G Messaging. As the aggregation entrance of home services, the 5G Messaging terminal, together with intelligent home IoT terminals, provides a unified home service portal and integrated service experience, builds a smart home ecosystem, and promotes the prosperity of smart home applications.

Function description:

1. Household appliance management
2. Home appliance control
3. Remote access
4. Data Collection
5. Multi-Screen Interaction

Summary: In addition to the above application scenarios, various industries, such as logistics, catering, transportation, health care, government administration, and Internet, as well as IoT terminals and applications, can provide one-stop services for all users through 5G Messaging and the unified entrances and use of native terminals.

9 Conclusion

The rapid, large-scale, and industrial popularization of 5G has started. It will build telecom services and digital information services in the new era based on 5G technology, AI, big data, cloud computing, IoT, and edge computing. How to reconstruct the prosperous ecosystem of telecom services is a major concern of the telecom industry.

5G Messaging technologies and services rely on telcos' phone numbers, SIM cards, native terminal entrances, security, and credibility to meet the multi-type communication requirements of "people-to-people, people-to-services, people-to-things, and things-to-services", and connect various human-centric ToC, ToB, and ToT terminals. The basic platform of 5G Messaging forms the intelligent information service infrastructure, leading the next-gen digital information services and the new era of "human-machine interaction."

Digital-based and service-based 5G Messaging has the potential to solve the internal requirements after the rapid development of 5G: 1) Contributing and providing 5G killer services; 2) Making great contributions to 5G business models and profit models; 3) Helping the 5G serve the public, various industries and even everything, and promoting massive IoT terminals to bring wider applications and higher value.

5G Messaging is an indispensable part of the 5G era and the digital innovation of science and technology. Through upgrade, telcos can provide personal Rich Messaging and business messaging in the 5G era, develop value-added services of 5G Messaging and upstream and downstream cooperative ecosystems, making great contributions to achieve ecological prosperity surrounding the communications industry and build the huge telecom ecosystem 2.0.

10 Abbreviations

Table 10-1 Abbreviations

Abbreviation	Description
3GPP	The 3rd Generation Partnership Project
5GC	5G Core Network
5GS	5G System
A2P	Application to Person
AI	Artificial Intelligence
APPU	Average Profit Per User)
AO	Application Originated
AS	Application Server
AT	Application Terminated
Chatbot	Chatbot
eMBB	enhanced Mobile Broadband
GSMA	Global System for Mobile Communications Association
HTTP	HyperText Transfer Protocol
IMS	IP Multimedia Subsystem
IoT	Internet of Things
LTE	Long Term Evolution
mMTC	Massive Machine Type Communication
MaaP	Messaging as a Platform
MO	Mobile Originated
MT	Mobile Terminated
NSA	Non-Standalone
NR	New Radio
OMA	Open Mobile Alliance
RCS	Rich Communication Suite
SA	Standalone
SDK	Software Development Kit
SMS	Short Message Service
SMSC	Short Message Service Center
SMSF	SMS Function
UP	Universal Profile
uRLLC	Ultra-Reliable and Low Latency Communications
VoLTE	Voice over LTE