Questions to be responded to by the firm submitting the application

Why do you think this project should receive an award? How does it demonstrate:

- innovation, quality, and professional excellence
- transparency and integrity in the management and project implementation
- sustainability and respect for the environment

China Mobile Communications Corporation (CMCC) Auto Test Management Platform is an analysis system involving big data analytics and cloud computing with automated collection and centralized management of mobile network signaling and sweep frequency data, being ranked as a primary trunk project of CMCC. The platform is capable of achieving real-time monitoring of mobile network quality, holographic positioning of issue and customer perception evaluation across the whole country.

The system breaks through conventional hierarchical management operation and maintenance mode in innovative manner, adopts highly unified and integrated remote testing module, centralized remote task customization, as well as real-time big data acquisition and distributed database management, cloud storage, distributed computing and precise GIS positioning without manual intervention, realizing the acquisition and processing of massive end-to-end hollow test data, creating pioneer practice of network operation and maintenance work matrix management, greatly improving the efficiency of network operation and maintenance, achieving energy conservation, emissions reduction and less operational input.

The platform supports drive test, fixed-point indoor test, commercial terminal test, massive business test probe, data sweep and other various data acquisition modes. Conjoint analysis and cluster on big data can be realized by adopting high-precise rasterized network quality positioning for fine granularity and intelligent screening on test issue. The combination of data and network construction of working parameters allows for closed-loop management of network quality and synchronous competitiveness analysis on network operators.

Currently, the system provides a commercial network quality test evaluation service for over 340 cities in 32 provinces and autonomous regions across China as well as CMPAK in Pakistan, supports more than 50,000 indoor coverage tests in total for seven major test scenes, and 9,877 all-around online concurrent 2/3/4G modules are available. The number of concurrent test equipment hits 1,411 units during peak operation and the volume of generated test data hit 2.8 TB within an hour, and it is compatible with any current global commercial mobile communication system and WLAN network.

The project was subjected to rolling development in three phases, and the mode adopted operation during construction. The project was started from 2009, and it was fully completed in April, 2014. The overall budget of the project is 250 million RMB while actual investment hit 245 million RMB, and the client of the project is CMCC.

Project particularly outstands in technical excellence, the efficiency of data acquisition improves 15 times and the workload of analysis personnel is reduced by 80% given that automatic testing process is applied, improving conception of wireless communication network effectively, providing a good communication network service for 8 billion CMCC network users, and making indelible contribution to the sustainable development of economy and society.

1 Innovation, high quality and technical excellence

CMCC Auto Test Management Platform is the first network analytic system in the world, and it is a national primary level test platform for all-weather automatic testing with free of dead zone and obtaining hollow data from multiple international communication network, its unique bottom layer data interface technology can pass back massive data remotely.

The platform raises acquisition approach of massive concurrent test data, architecture of efficient linear scaling distributed database system, preliminary statistics scheme of high performance data processing, automatic configuration-based physical grid processing scheme, GIS monitoring technology solutions and Hadoop-based big data processing technology, solving the issue of synchronous acquisition on wide range massive data and efficient data processing, decreasing the consumption on manpower, material and financial resource when compared to data acquisition and processing in manual manner, and improving the production efficiency by 10 times.

The platform innovativeness raises real-time and comprehensive monitoring over the network in the process of testing, solving the issue that network cannot quickly capture and fast positioning while providing primary data source for network optimization effectively, greatly guaranteeing the accuracy and real-time performance of the data. The platform supports many network systems: GSM, CDMA1X, TD-SCDMA, EVDO, WCDMA, HSPA+, TD-LTE, FDD LTE. Furthermore, the front-end data collection and analysis can be realized on a global scale.

1) Concurrent acquisition solution on massive test data processing

The system involves over 5,500 ATU terminals, 500 sets of testing instruments, and over 20,000 commercial terminals. The instantaneity and accuracy of concurrent data acquisition and processing is an important part for auto drive test. Serial and concurrent distribution mode for processing link is used for data acquisition, and message queue is used for data transmission.

2) Architecture of efficient linear scaling database system

According to characteristics of data, the architecture of database system achieves the deployment of multi-node distributed database system by applying the idea of multi dimensional cutting algorithm.

3) Preliminary statistics solution for efficient data processing scheme

Preliminary statistics is a moderate processing procedure that test data is presented to user via report or report in unified format. It imposes certain tolerance and analytical ability of unified processing on equipment manufacturers with different devices and chip manufactures. And the index statistics is the key to increase the degree of customer experience in accordance with different dimension indexes. The solution improves the efficiency of data query by acquiring 1T data statistics results within few seconds using the platform.

4) GIS analysis --- automated configuration based geographical grid processing

GIS analysis is an extremely important module among data analysis tools. GIS module can provide the users with intuitional presentation of existing network data distribution and geographic basis for drive test analysis, sweep frequency data and network quality optimization. The combination of Flex client and Java server is applied to present analysis results. After the results are processed, the server can release map service and process GIS request from the client.

5) GIS monitoring technology

GIS monitoring solution can be utilized without testers, and there are only few numbers of staff needed for monitoring if test positions and operation of big number of test equipment are normal and prevent test failure resulted from equipment problems, save labor cost, avoid repetitive work and improve efficiency.

GIS monitoring is utilized to receive the pass-back data (GPS information, information equipment, warming information, event information, MOS information, etc.) in real-time manner, and GPS information and special event information are displayed on Google Map. The system framework is realized by the way of rich client platform, the service part is deployed on the server acquiring the data, and the map display, data processing display and user operations are deployed on the client.

6) State-machine based drive test events determination algorithm

The mechanism of state-machine based event determination is changing via the service state. The specification of signaling order can be determined via state machine, error checking and correction functions may be synchronously handled to output events and provide basic business processes data.

The solution can restore normal or abnormal events from the network test results. Firstly coordinate with signal analysis to get event, and then determine the cause of the incident according to the analysis on test results. These determinations will contribute to finding and solving problems existing in the network, thereby providing the assistance to network operator with directly improvement on user perception and the quality of network operation.

7) Hadoop-based data processing technology

In addition to support national large-scale testing evaluation, powerful means are also systematically provided in the aspect of operation depth. 25 * 25 m rasterized processing is taken in key areas including cities, villages, towns, scenic spots, universities, industrial parks and others, forming nearly 80 million basic grid data. And the coverage, quality and business awareness of each grid can be realized in real-time manner, effectively meeting the requirements of CMCC on refined evaluation and optimization of network quality.

In order to process massive test data efficiently and support the analysis on the refinement of massive grids, the system adopts big data technology and industrial leading Hadoop-based data platform, and builds distributed processing architecture of test data.

2 Patent application

A number of industry innovative technologies are adopted for the development of overall platform, and independent development and intellectual property are persisted to improve the level and efficiency of overall network maintenance. The project has already been registered with nine patents and won two national software copyrights.

Proprietary Name	Patent No.	Description
Drive test information processing method and apparatus	ZL 2010101868422	Through the use of fragmentation, message queues, background parallel processing technology to achieve accurate real-time data transmission
Drive test data playback method and apparatus	ZL 201010186828.2	Specific indicators in drive test logs can be selected for playback processing, effectively providing the flexibility of test data playback.
Method and apparatus for positioning a base station site	ZL 201310295741.2	According to the strength of carrier signal, attenuation factor, geographical environment correction factor and other relevant information can be obtained to predict coverage of signal, realizing precise positioning of cell sites.
Method and apparatus for determining network events	ZL 200910237271.8	Automatically determine network events based on status migration of signaling to pinpoint the problems and discrimination.
Method and apparatus for generating neighbor cell to different system	ZL 200910088865.7	Based on weighting algorithm, the list of neighbor cell to different system can be automatically obtained to reduce system load and improve network performance.
Method and apparatus for optimizing neighbor cell	ZL 200910089328.4	Based on the results of sweep frequency, priority algorithm is adopted for automatically optimizing neighbor cell to improve reliability and accuracy.
Cell parameters and system configuration method	ZL 200910091669.5	According to 2/3G signal quality distribution, network standard feature and different scenarios, automatic parameter configuration is achieved to improve network optimization efficiency.
Method and apparatus for an inter-system neighbor cell generation	ZL 200910088864.2	Using by the list of 2/3G neighbor cell configuration, the realization of inter-system neighbor cell automatically generation reduce system load and improve network performance.
Network test equipment	ZL 201220541750.6	Simultaneously acquiring drive test and sweep frequency data to fully reflect the coverage of network, improve the efficiency of network testing.

3 Sustainability and environment respect

Past artificial test means are featured with limited data information, heavy randomness and possibility, expensive labor cost, wasteful hardware resources and low utilization rate of test data. Comparatively, Auto Test Management Platform with a centralized data acquisition, processing and analysis greatly reduces manual intervention thanks to the method of automatic data acquisition, statistics feedback and analysis applied.

Given that daily consumption of gasoline is approximately 60 liters, drive test consumes 10,560 liters for 22 days in 8 months per annum. Highly integrated remote testing module is embedded with eight test modules without configuring a large number of single-mode terminals, realizing synchronous acquisition of multi-channel data. Compared to only two test equipment in each vehicle by artificial drive test method, automatic drive test can save 31,680 liters of gasoline with regular density of test road, simultaneously reducing workload and corresponding vehicle and fuel consumption, making positive contribution to the slowing of global warming by reducing carbon emissions.

With optimization of the system architecture, 5 private cloud servers (200w per hour) and 10 PC servers (400w per hour) can be saved due to application of load balancing server and reduction of peak load. Fewer cabinets are expected to access to the system with centralized server room layout. Approximately, (200w*5+400w*10)*24*30*365=1,314,000 degrees can be saved annually.

The application of Auto Test Management Platform is a major reform and breakthrough of operational work, embodying the operation and maintenance work shifts to centralized monitoring, maintenance and management. Annual investment on hollow data collection and analysis work dropped from 120 million RMB to 24 million RMB, greatly improving the labor productivity and being unprecedented in the industry. Scattered and isolated management status in provinces and cities in the past is changed through the system, providing an effective mean of quality control and contrast mean for whole business development.

4 Transparence and integrity

The project's scope, time, schedule, quality, purchasing and risk are implemented with requirements on project management during the execution, milestones including project planning, project launch, project control and project implementation are provided with corresponding meetings, review records, research & development design documents as well as demand design document, and centralized management is selected for documents via SVN.

The project is implemented in strict accordance with appropriate national laws and regulations. Hardware and software equipment of the project purchasing processes are in the manner of public tendering, and project management personnel are required to sign the integrity letter of commitment.

What services did the member firm provide to the project? Please describe briefly.

CMCC Auto Test Management Platform feasibility study, system design, application software function design, code development, system debugging, process of system integration and construction (progress of research and development, configuration, quality control, software & hardware deployment, testing and debugging of application system)

Please use additional pages as needed. Maximum 5 pages per project.