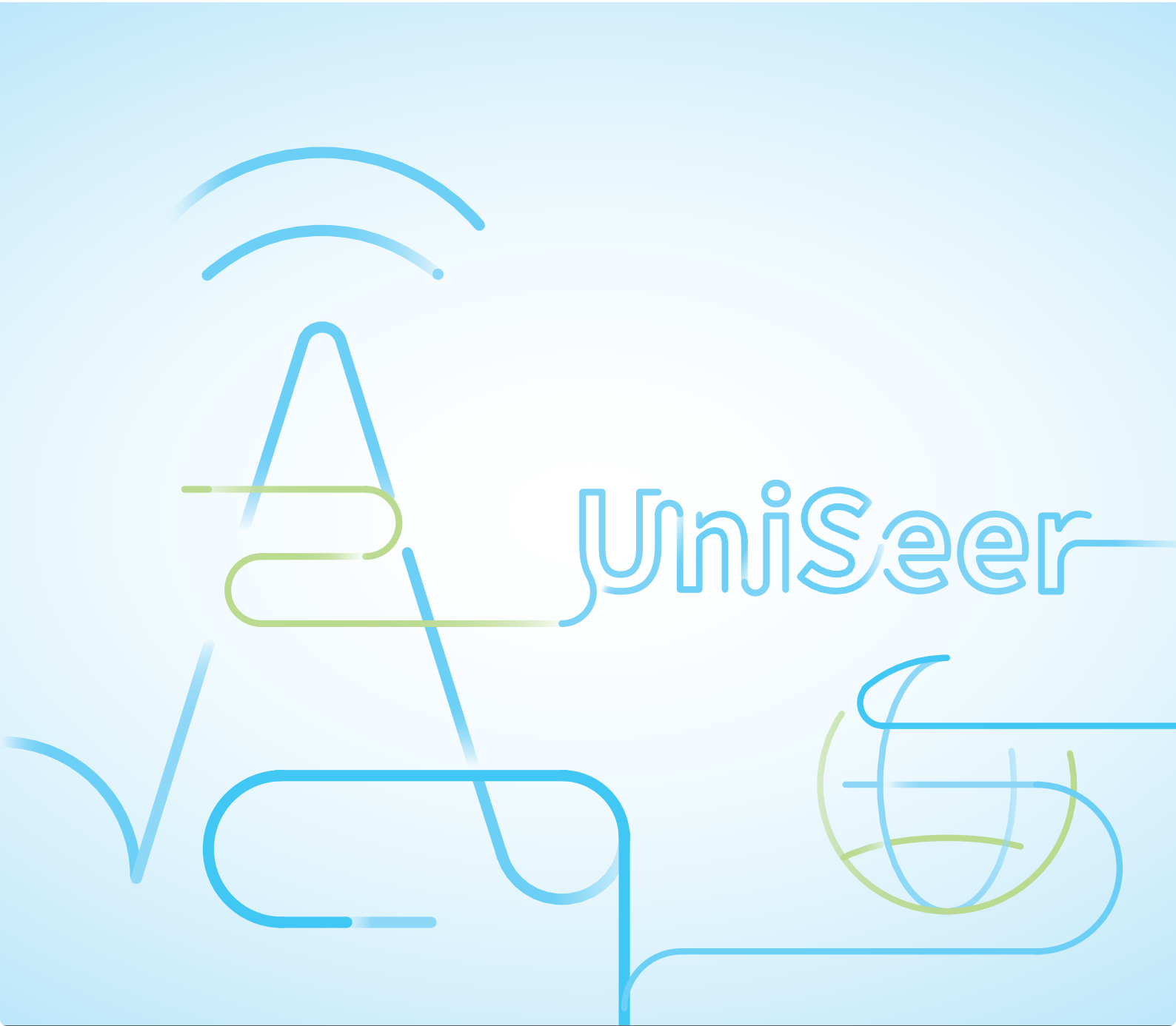
ZTE

ZTE UniSeer
Intelligent Network Operation
White Paper



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Industry Trends and Challenges

Challenges to operators in the transformation into digital O&M

As network complexity rising up and operation pressure increasing, more and more providers are concerning on O&M efficiency improving and OPEX reducing, while, most network O&M are heavily rely on personal experiences. As consequences, traditional O&M work are facing great challenges, meanwhile, data based O&M evolutionary mechanism involving big data and AI techniques scrambled points-of-interest among network operators in achieving lower cost and higher work efficiency by highly automated and intelligent operations.

Low degree of data

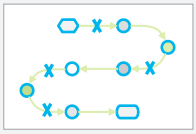
- Data governance insufficient, the accuracy and standardization need to be improved
- Data islands, lack of unified data collection and standardized processing

Difficult fault location

- The network is more complicated, difficult to locate fault, and relies on manual experience
- Delayed troubleshooting results in high MTTR

Passive O&M

- Passive responses: There is a lack of prediction and preventive measures in advance
- Low skills of personnel, lack of knowledge and understanding of AI + big data



Low automation

- Low automation (automation level lower than 20%)
- The efficiency of troubleshooting and resource scheduling is low

The transformation from traditional O&M to digital O&M faces the following challenges:

Low degree of data collection

The lack of a unified data collection and governance platform has led to data chimneys and data islands.For example, there is a lack of effective data collection for operation and maintenance resources such as personnel, vehicles, diesel engines, and spare parts, it is impossible to measure its operational efficiency. The low degree of digitization hinders the application of new technologies such as big data and AI in the field of O&M.

Low degree of automation

With the increase in network complexity, the traditional O&M relies on the long-term experience and professional level, lacks the ability of automation, resulting in the efficiency and, quality of O&M difficult to improve.

Weak ability in prediction and prevention

The traditional O&M mode is mainly based on passive response, and lacks the ability to predict and prevent faults in advance. When a fault occurs, emergency repair is performed again to remove the fault. This cannot meet users' higher service quality requirements. The ability to predict and prevent faults needs to be improved, and preventive measures should be taken in advance to reduce the probability of fault occurrence.

Lack of intelligent O&M capability

The traditional O&M mode mainly relies on artificial experience in data analysis and fault location. It is difficult to locate faults in complicated network situations. It is urgent to carry out integrated intelligent analysis and end-to-end delimiting and location through big data and AI technology, and intelligent service closed-loop based intelligent O&M.

Intelligent O&M based on big data and AI becoming a trend of telecom O&M

Taking the opportunity of 5G, intelligent O&M based on big data and AI has become a trend of telecom network O&M. Through the application of big data and AI technology, the automation and intelligence capabilities are improved, and the overall efficiency of network O&M is improved.

Flat network

- Centralized monitoring and centralized management
- Regional Grid Management
- Integrated O&M and operation
- ICT and FMC O&M
- Combination of on-site optimization and maintenance services

Tool evolution

- Unified O&M management for multiple manufacturers
- A unified data platform is established for multi-dimensional data management and comprehensive analysis
- Evolution from the Platform to the Intelligent Middle Platform
- Building up DevOps development and operation capability
- OSS capability exposure

Automatic/intelligent O&M

- Fault prediction and abnormality detection
- Intelligent root cause analysis
- Automatic ticket allocation and work order compression
- Automatic fault diagnosis and recovery
- Smart dispatch of O&M personnel and vehicles

NOC/SOC integration

- NOC+SOC integration deployment, system interface interconnection, service flow closed loop
- Association analysis and root cause location of service and network problems
- NOC+SOC unified view and O&M score
- Multi-dimensional data-based cross-domain value scenario mining

DevOps

With the integration of ICT, the capability of service design, orchestration, development, service provisioning and policy-based assurance shall be improved to meet the operation and maintenance requirements quickly.

Multiple data aggregation

Various data assets exist in network. It is an imminent work to maximize the value of data mining to support O&M through unified data collection and data governance.

Automatic and intelligent O&M

By introducing big data and AI technologies, such as fault prediction, intelligent RCA, and automatic dispatch to improve O&M efficiency.

ZTE UniSeer Intelligent Network Operation

The ZTE UniSeer intelligent network O&M solution is a network O&M solution to realize digital O&M transformation and automatic and intelligent O&M. Taking the opportunity of 5G, the solution analyzes O&M data by introducing big data and AI technology, so as to empower O&M services, thus improving the network O&M efficiency, gradually evolving towards Zero touch Operation, and realizing the rapid transformation of digital and intelligent O&M.

Overall idea of intelligent network operation

The ZTE UniSeer intelligent O&M solution builds a hierarchical and closed-loop intelligent O&M system based on data and AI middle platform, and achieves easy O&M through "hierarchical autonomous, vertical coordination".

Hierarchical closed loop

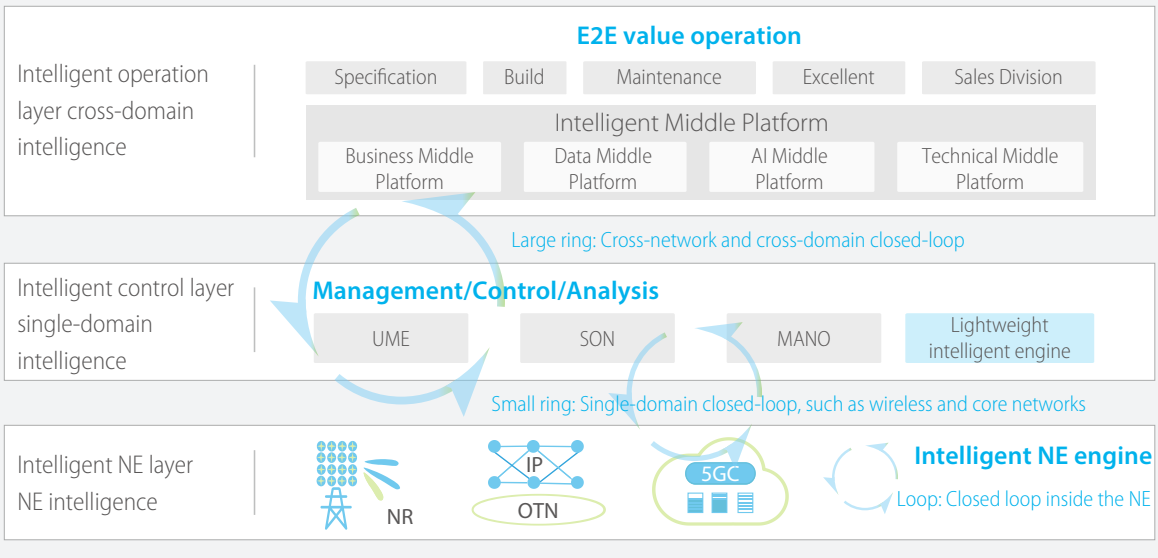
Self-loop, small loop, and large loop implement in NE, single-domain, and cross-domain respectively. At the OSS level, the end-to-end intelligent O&M capability of large rings is improved.

Level-by-level evolution

In the L1 ~ L5 intelligent stages, it gradually evolves from L1 auxiliary intelligence, L2 primary intelligence, L3 intermediate intelligence, L4 advanced intelligence and L5 full intelligence to Zero Touch Operation.

Modular introduction

Application microservices and componentization, and flexible assembly of service modules, facilitating interconnection and integration with operators' existing systems.

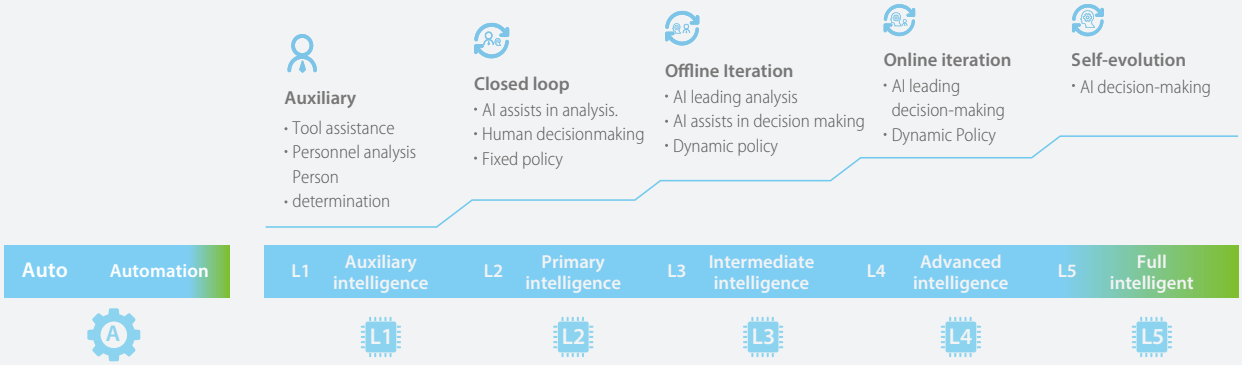


The main trend of intelligent network O&M evolution is as follows:

Active	Automation	Intelligent
Evolution from passive responses to early prediction and prevention	Evolution from manual processing to automation	Evolution from manual experience to intelligent analysis and decision making

Intelligent operation evolution phase

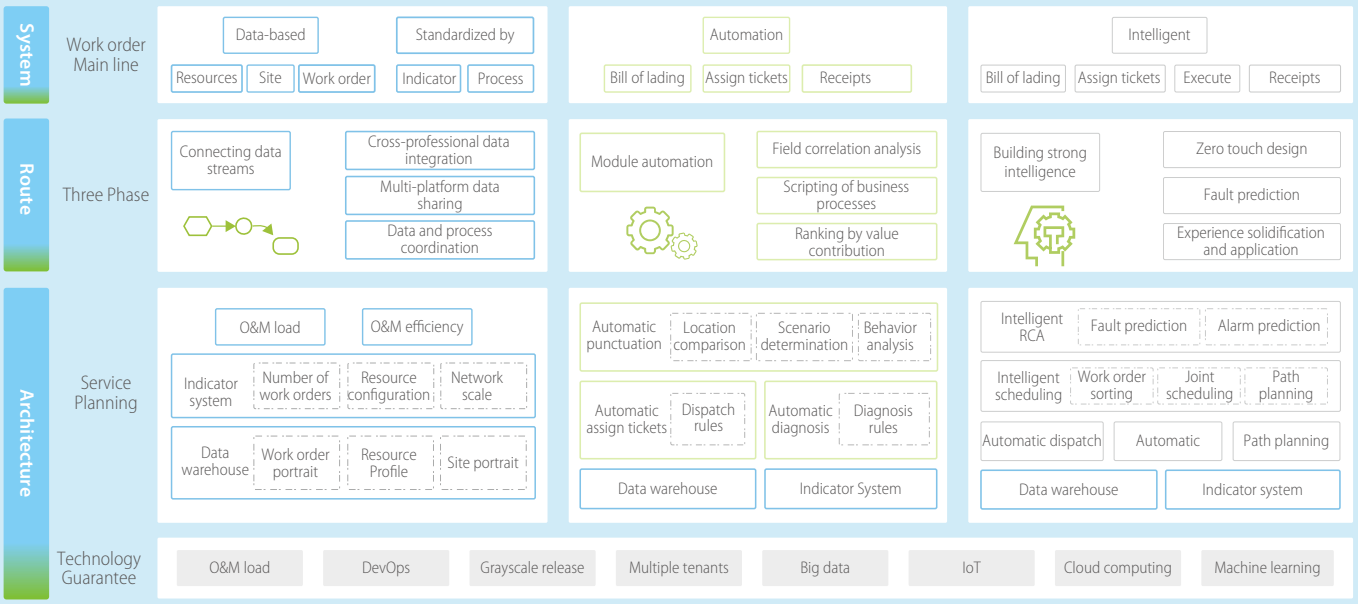
Automation is usually implemented by predefined process. Intelligence further introduces AI to make complicated analysis and decision. Intelligent operation is divided into five stages, from tool assistance to final self-decision by AI (manual intervention is only required in case of emergency). At present, most operators are in the L2/L3 stage.



Intelligence Level	Automation	AI- level 1	AI- level 2	AI- level 3	AI- level 4	AI- level 5
Execute	Tools +manual	AI+ manual	AI + manual (emergency intervention)			
Data Collection	Tools +manual	+AI	AI+ manual			
Analysis	Tools +manual	manual	+AI	AI+ manual		
Decision	Tools +manual	manual	manual	+AI	AI+ manual	
Solution Implementation	manual	manual	manual	manual	+AI	

Digital maintenance system for intelligent O&M

Benefit from years of experiences in managed services, ZTE has built up a digital O&M mechanism by applying working-order lines as a main concerned factor, according to continuous technological innovation and service transformation. In order to solve problems from alarms to closed-loop of work orders, such as a large number of alarms, inaccurate dispatch of work orders, and many manual intervention procedures, ZTE has explored fault management automation through the introduction of automation, big data, and AI. The automatic closed-loop level of work orders is improved, and digital network O&M can be rapidly transformed through data management, automation, and intelligence.



Building end-to-end automation and intelligence

ZTE UniSeer intelligent network operation focuses on intelligent policy, with work orders as the main line, and end-to-end O&M efficiency is improved through automatic and intelligent means on key O&M paths.

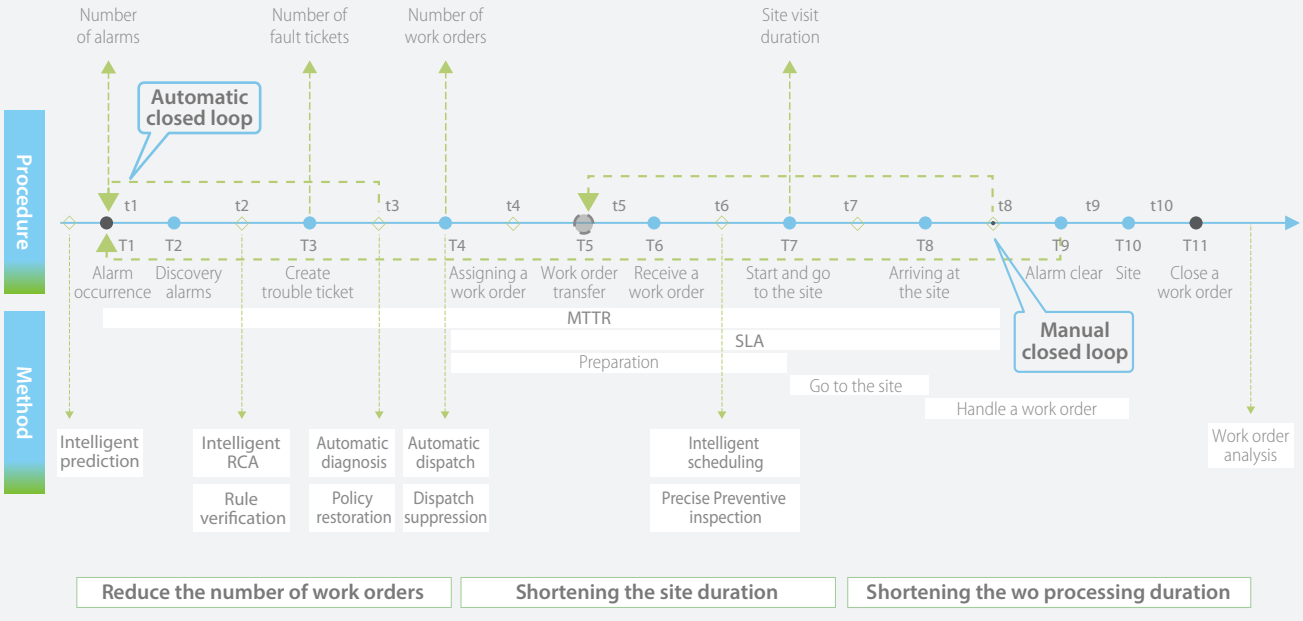
Intelligent prediction: Through intelligent fault prediction, operators can change from passive emergency repair to active prediction and prevention.

Intelligent RCA: Intelligent mining of alarm association rules improves rule generation efficiency and implements alarm association.

Intelligent diagnosis: Automatic diagnosis and recovery are implemented by invoking intelligent policies to achieve automatic closed loop.

Intelligent work order dispatch: The work order dispatch efficiency is improved through automatic work order dispatch, and invalid work order dispatch is reduced through dynamic work order suppression.

Intelligent scheduling: Through multi-vehicle and cross-professional joint scheduling, the best scheduling solution is provided to improve the efficiency of field O&M.



Achieving intelligent network operation objectives: predictable, fast, and accurate.

Predictable: The network's status is continuously detected, failures or exceptions can be predicted by analyzing history data performing, and the predict results can prevent networks or devices from fatal errors.

Fast: Service and network faults can be located quickly and accurately through smart root cause analysis, site portraits, and precise preventive maintenance applications.

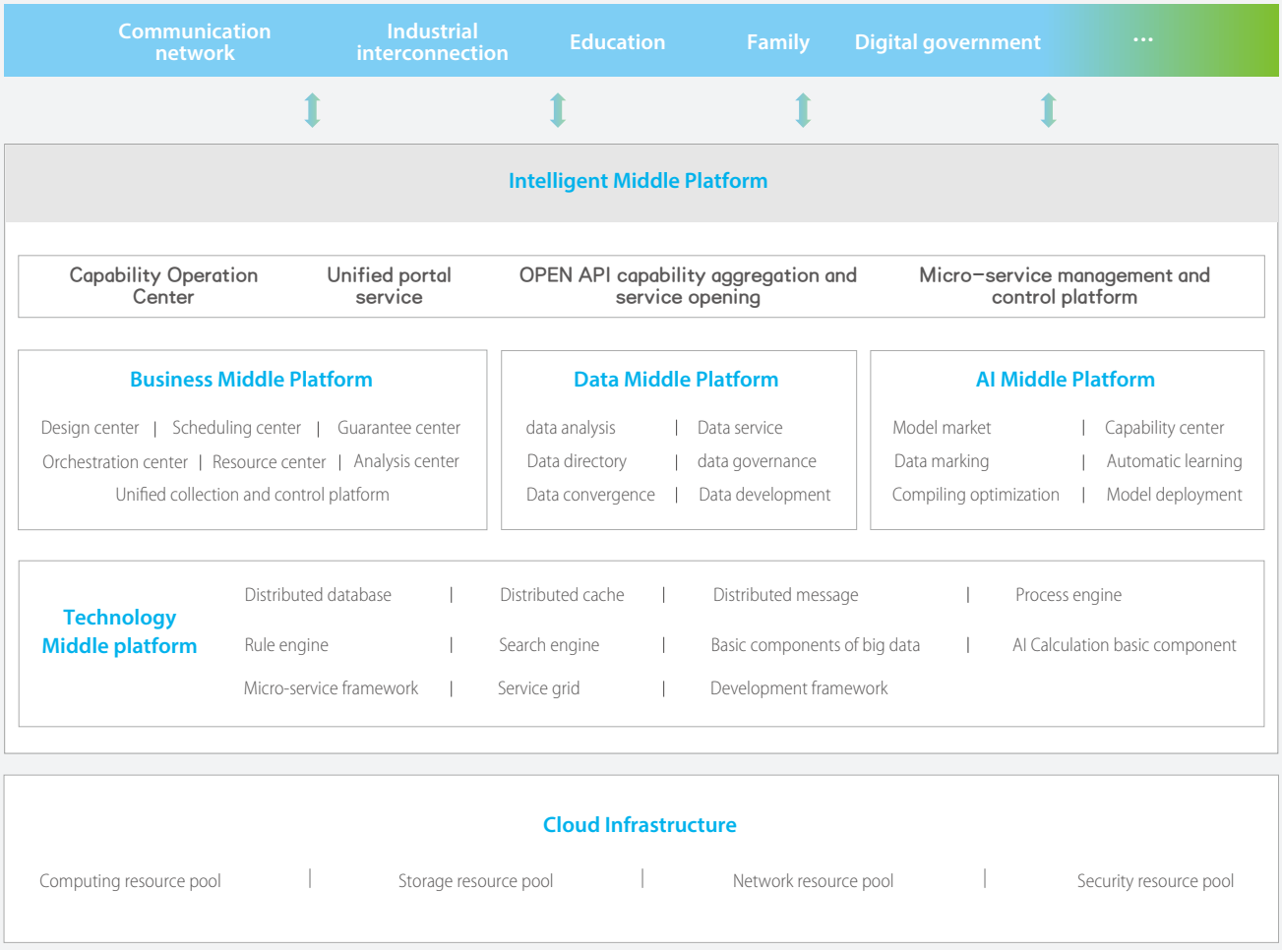
Accurate: Failure automation is realized through automatic work order assignment, diagnosis and recovery without manual intervention.

O&M objectives		Typical intelligent O&M scenario
Advance	Discovery: From passive response to active prevention	Fault prediction | Abnormality detection
Accurate	Location: Precisely locate service and network faults	Intelligent RCA | Root cause location Service end-to-end delimitation | Precise preventive inspection
Fast	Closed loop: Automatic closed loop from SLA to Zero Touch	Automatic dispatch | Automatic diagnosis and recovery

ZTE UniSeer Intelligent Network Operation Platform

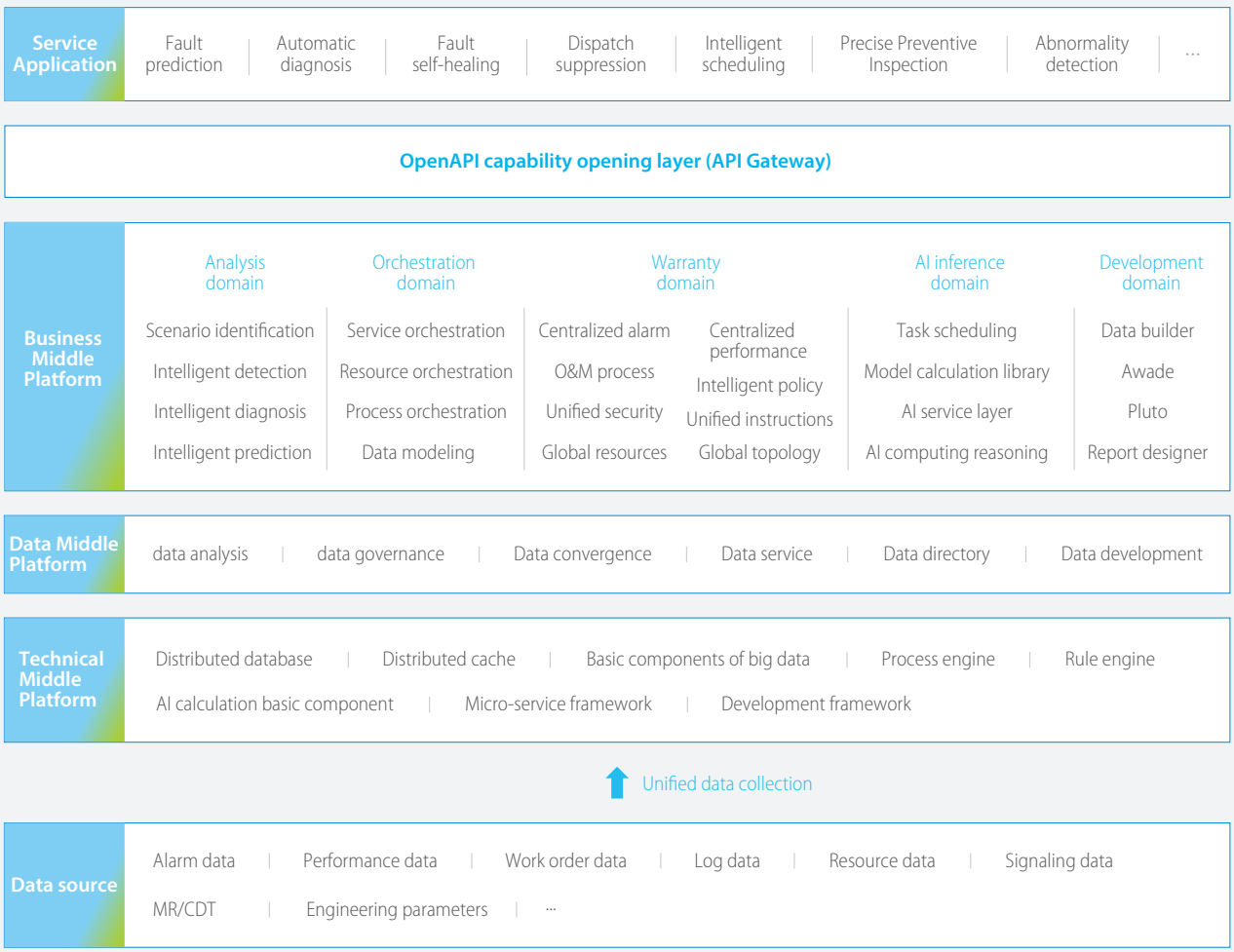
Architecture of UniSeer intelligent network operation platform

The overall architecture of the ZTE intelligent network Operation platform includes the business middle platform, data middle platform, AI middle platform, and technology middle platform, which support upper-layer O&M applications. Such middle platforms can be deployed as a whole or flexibly interconnected with the existing system of the operator in a modular manner. ZTE can provide specific middle platform products, such as CloudStudio OSS, VMAX and AIE.



Business middle platform

The business middle platform is divided into the analysis domain, orchestration domain, assurance domain, AI inference domain, and development domain. It provides a unified architecture and integrates application components into microservices, and OSS services with big data and AI technologies. Through open capabilities and flexible combinations, it provides fast R&D application capabilities for intelligent network O&M services.



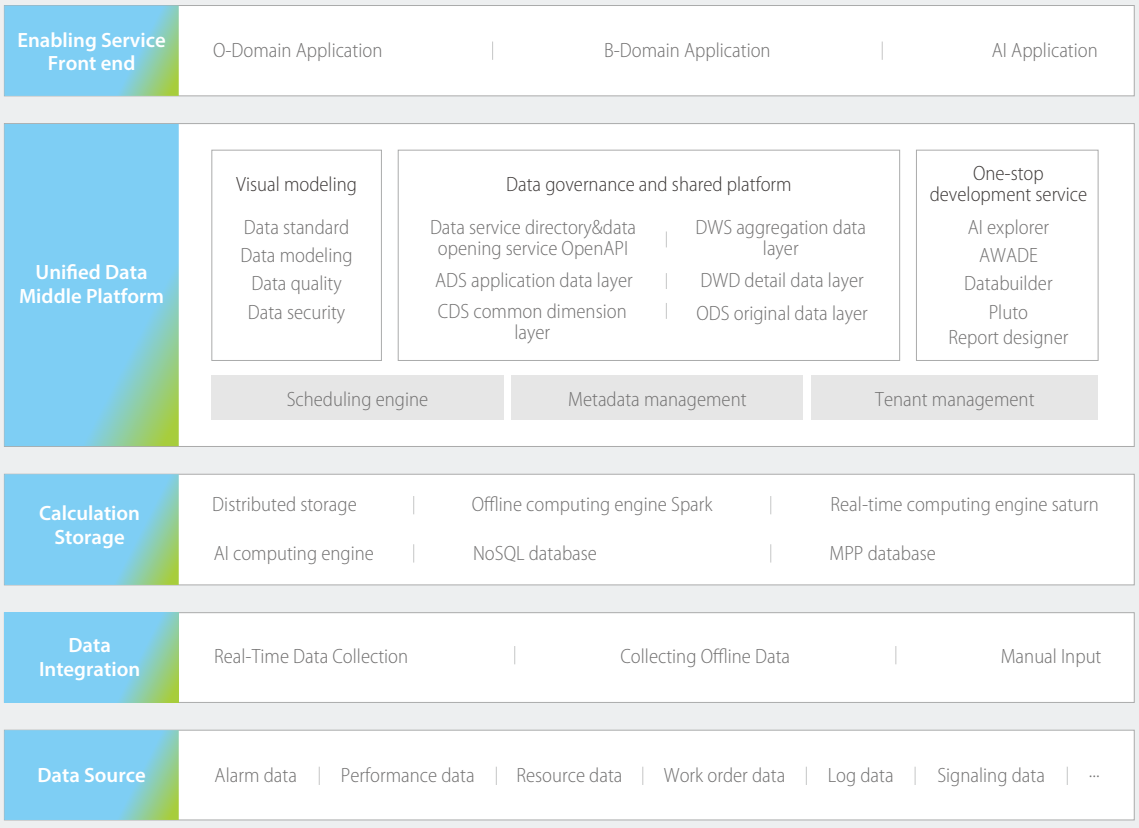
The business middle platform supports the E2E O&M with cloud network integration, shares service capabilities and interconnects processes, and supports service development and innovation.

Data middle platform

The data middle platform performs data governance based on the unified data standard, and establishes a standardized, clear and shared hierarchical data architecture to provide unified external data services.

The data middle platform provides two major capabilities:

- Through visual modeling of the entire process, data architects can build standardized and shared data models.
- The one-stop development service supports rapid exploration and development of data applications, allows application developers to customize applications to meet O&M requirements.



The data middle platform can improve the efficiency of data governance, effectively improve the data quality, reduce the construction cost, eliminate the data islands, give full play to the value of data assets, and effectively support the intelligent network operation.

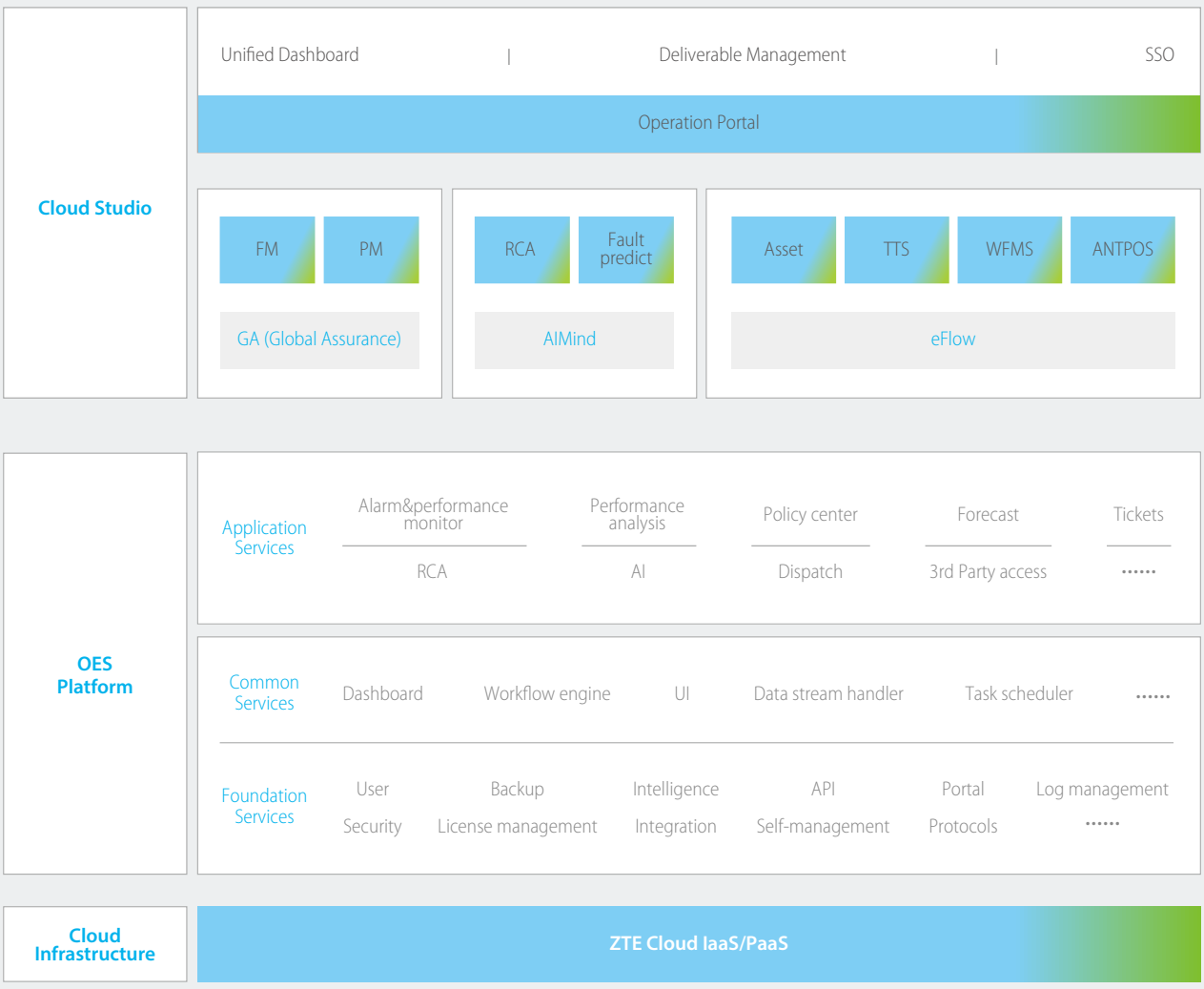
AI middle platform

The AI Middle Platform empowers the network O&M, enriches AI application scenarios such as prediction and fault delimiting and location, and supports automatic and intelligent closed-loop network O&M. The AI middle platform can provide complete data management, AI training, compilation and optimization, capability center and AI inference, According to the application features, the inference engine can be divided into RSE, LSE and VSE:

- As a real-time smart engine, RSE is integrated into the NE to provide real-time inference.
- LSE is a lightweight smart engine, which is integrated into the management and control layer tools such as the NM. It supports lightweight AI applications with low real-time requirements, low computing capability requirements.
- VSE is integrated with the big data platform to support complex computing and reasoning.

UniSeer intelligent network operation tool -CloudStudio OSS

The business middle platform product CloudStudio OSS includes alarm management (FM), performance management (PM), AIMind, eFlow and Unified Dashboard.



Key capabilities: Microservices platform, automatic closed-loop, and capability openness

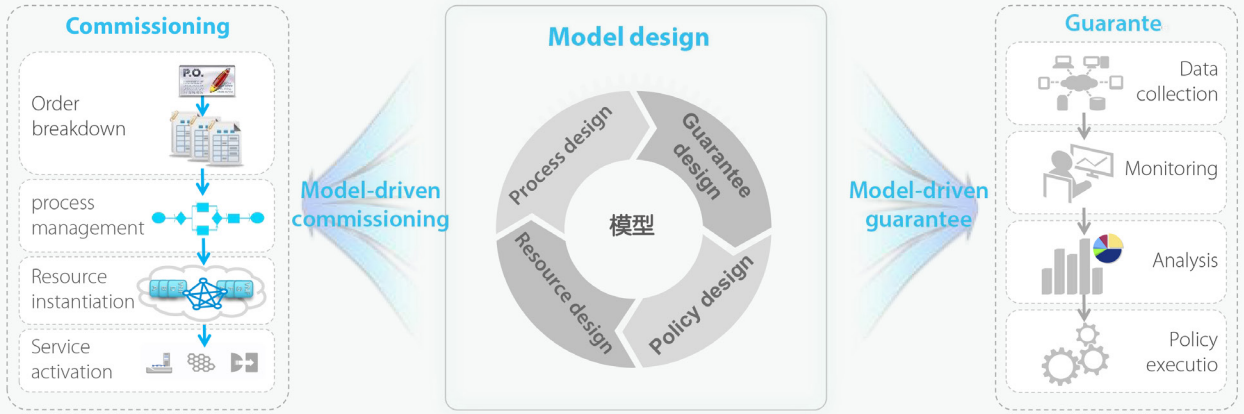
The CloudStudio OSS uses a cloud-based architecture with the following features:

- **Microservices:** Based on the PaaS platform, microservices are available for flexible assembly.
- **Automatic closed-loop:** Policy center is used to achieve policy-based closed loop for end-to-end services.
- **Capability openness:** Provides OpenAPI for interconnection with third-party systems.
- **Intelligent embedded:** The AI inference engine is embedded to support various intelligent application scenarios.

Microservice architecture PaaS	PaaS-based microservice bus, microservice registration/discovery, and microservice management and control, providing universal middleware and basic cloud services
Open capability platform OpenAPI	Open capabilities based on cloud and microservices provide users with the capability of customizing operation and maintenance online, and build an operation and maintenance ecosystem
Automatic closure COMPA	Automatic policy-based O&M: End-to-end integrated process of design, orchestration, control, collection, analysis, and policy execution
Intelligent introduction Bigdata/AI	The big data, AI, and other intelligent applications implement component-based decoupling design, and are embedded at all network levels in the form of lightweight/modular design to meet the deployment requirements in various scenarios

Key capabilities: Model-driven, zero code for commissioning and assurance

The CloudStudio OSS has the self-orchestration capability based on the model. It supports fast orchestration of operation process by invoking the model library and dragging and dropping the graphical interface, and supports automatic service provisioning and automatic assurance.



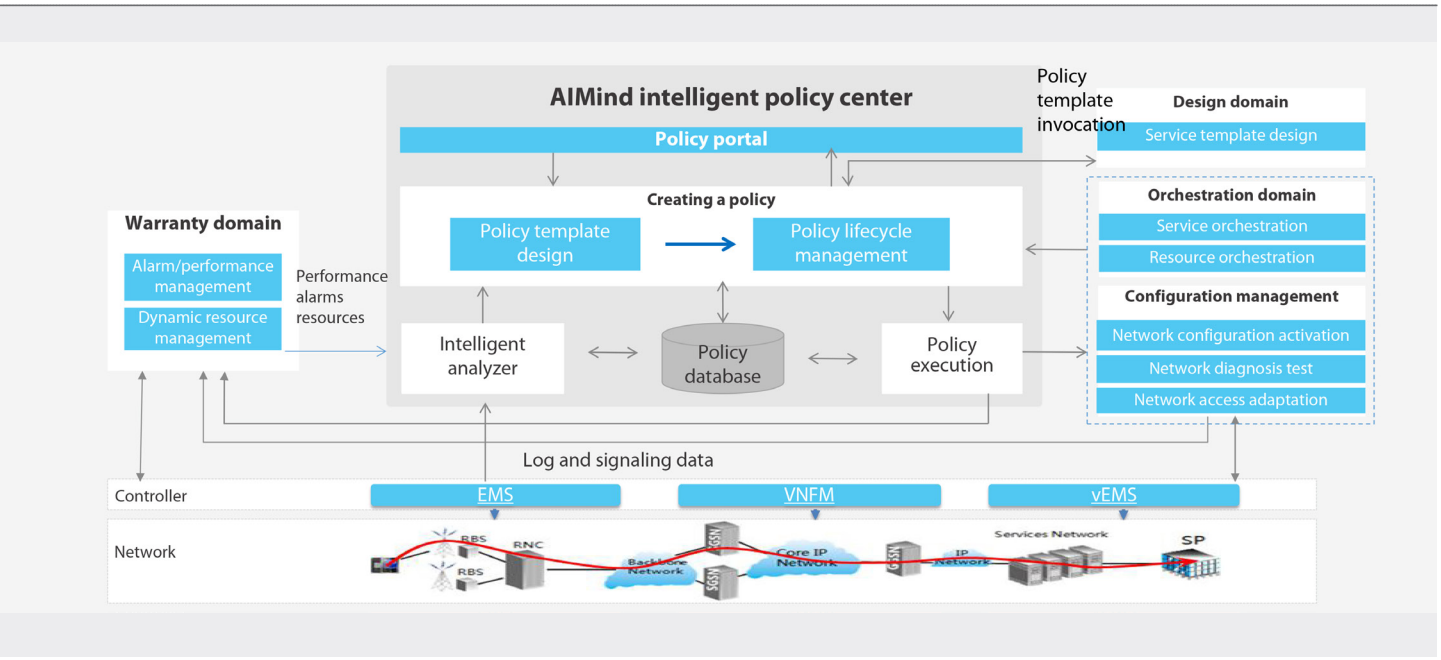
Automatic commissioning

Automatically starting the assurance policy

Unify the model design of full lifecycle management to implement cross-domain, cross-manufacturer and cross-operator E2E provisioning and guarantee

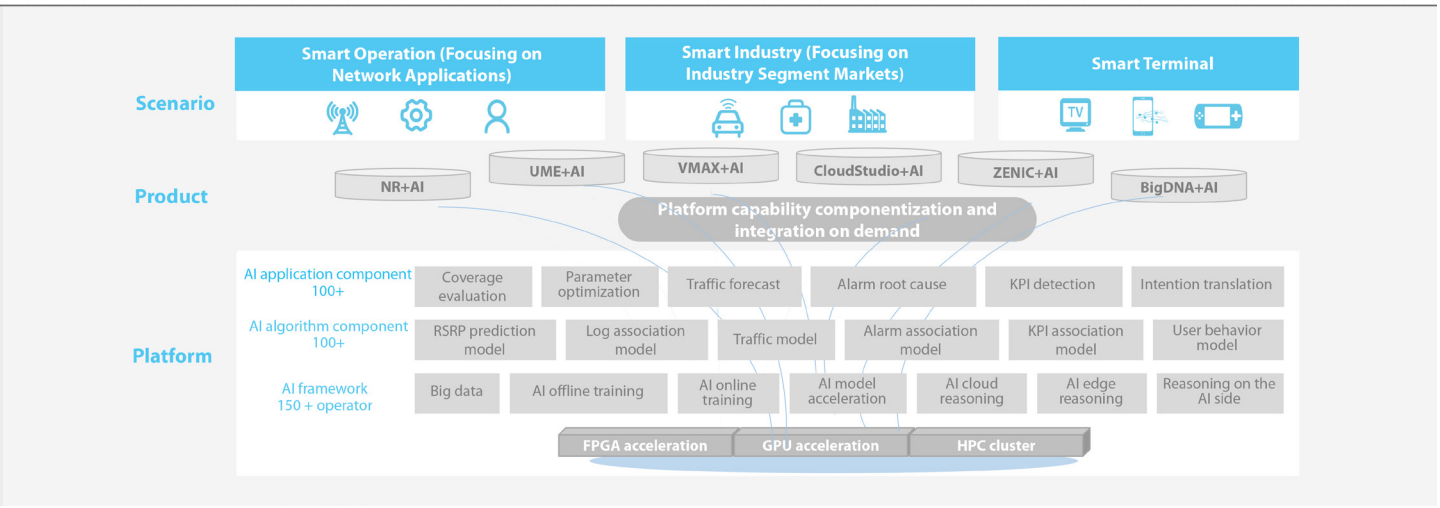
Key capabilities: Smart policy center drives closed-loop automation of network operation

The design of the policy is implemented by the AIMind intelligent policy center, which supports policy orchestration. The expert experience can be solidified as automatic rules, or the optimal policy can be formed through the analysis of historical data by AI. When the triggering conditions are met, the corresponding policies are invoked from the policy library, and instructions are delivered through the global provision center to implement policy execution and closed loop.



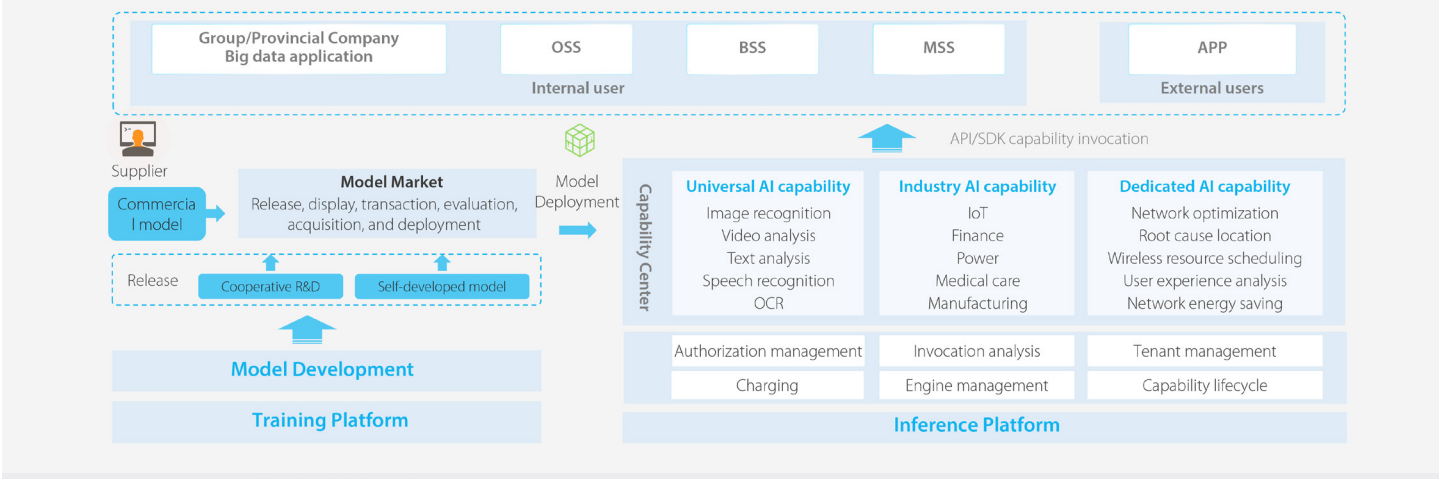
UniSeer intelligent network operation tool -AIE

AIE is part of AI middle platform. It provides abundant model capabilities (100 + of AI application component, 100 + of AI algorithm component and 150 + of AI operator). It provides visual development mode to improve the efficiency of AI model development. It provides automatic engineering optimization to improve the operation efficiency deployed on different platforms. It also provides abundant API/SDK interfaces for interconnection with other service systems. It supports the access of big data storage platform and relational database. It also supports secondary development and algorithm import. Supports integration with different tools in the form of AI engines to support the implementation of various upper-layer intelligent applications.



Powered AI capabilities: Building and opening AI capabilities

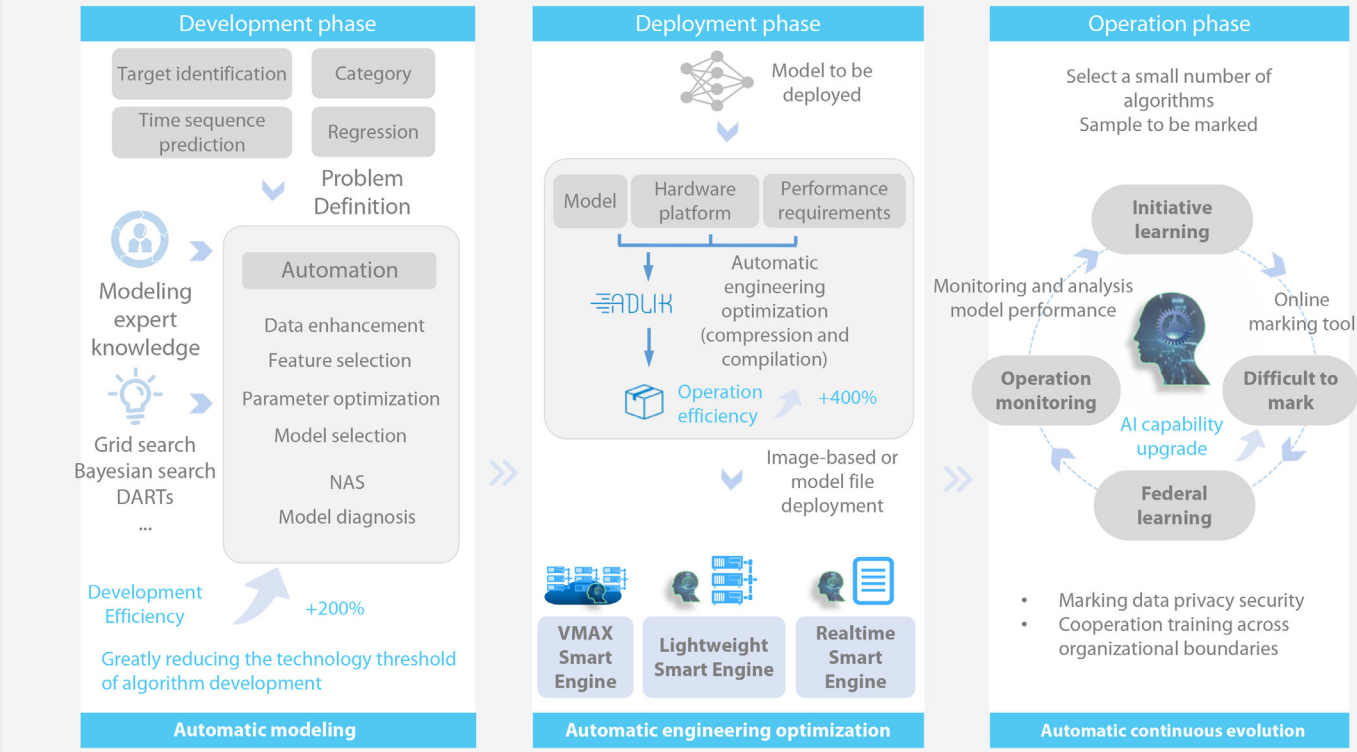
The training platform provides the capability of developing and releasing the model. The model may include the commercial model, self-developed model and cooperative development model. The AI model can be released, displayed, traded, evaluated and obtained through the model market. The capability center provides various applications to support different application scenarios, which can be invoked externally through the API/SDK interface.



End-to-end automation: Improvement of AI application development, deployment, and operation efficiency

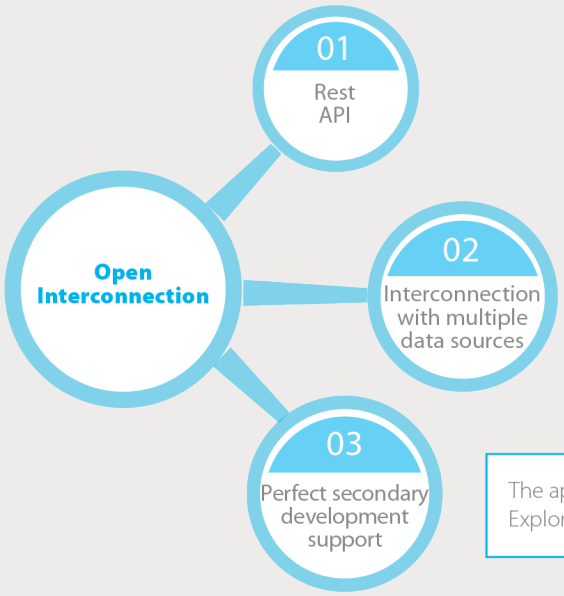
AIE improves the end-to-end automation efficiency of AI application development, deployment and operation, including:

- The automatic modeling capability in the development phase improves the development efficiency of AI models.
- Automatic engineering optimization in the deployment phase improves operation efficiency deployed on different platforms.
- Automatic continuous evolution in the operation phase to achieve continuous improvement of AI capabilities



AI openness capabilities: OpenAPI supports interconnection for third-party systems

The AIE tool provides abundant HTTP Rest API interfaces to interconnect with other service systems, supports the access of big data storage platform and relational database, and supports secondary development and algorithm import.



Providing abundant HTTP Rest API interfaces to facilitate interaction with other service systems to form a closed loop of information flow

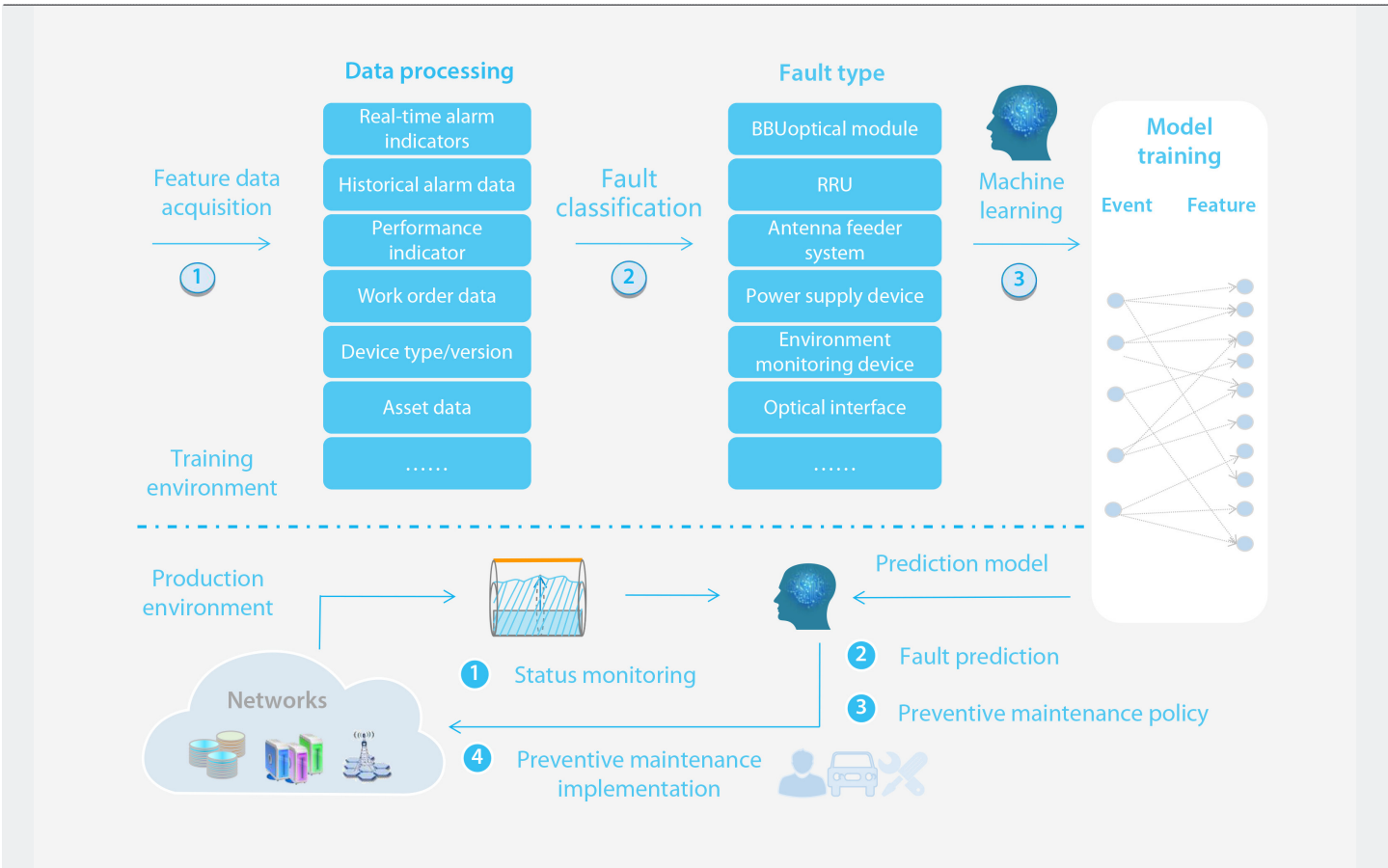
Based on the ZTE big data platform, supporting the access of the big data storage platform and relational database

The application service can import its own special algorithm into AI Explorer to achieve consistent modeling with other components

Typical Application Scenarios

Fault prediction: Applying history operation data to predict the future site fault status

Hundreds of thousands of alarms are generated from the communication network anytime since it starts running. Take the radio access network as an example, the site will report 'site down' alarms to the EMS when it lose antenna signals, so as to the power supply shortage enforce the site report related alarms. By applying machine learning from the history data, the future site status can be predicted after a serial AI procedures.



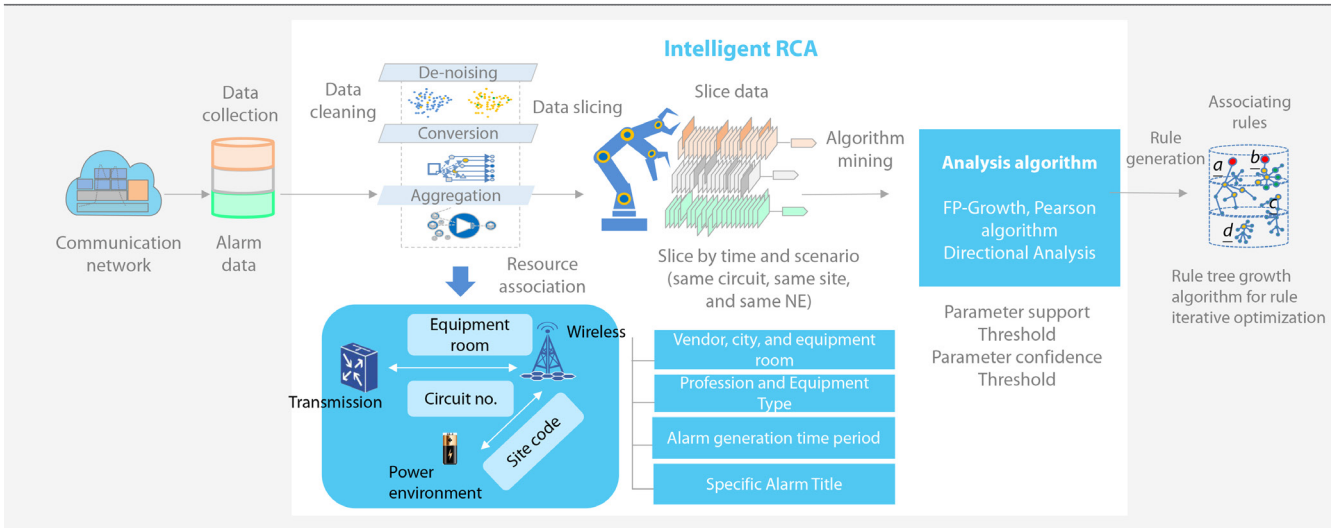
One reliable prediction system can be designed as follows:

- First of all, conduct the data analysis, such as alarm and asset data association, trouble ticket and performance indexes co-analysis, work-order and device diagnosis data comparisons, etc.
- Then, adopt suitable quantification of time label and grab data characteristics to constitute the prediction model.
- Finally, training the model with the history operating data, and predict site status with latest samples.

Intelligent RCA: AI-based alarm association rule mining, improving alarm compression rate

By obtaining original alarm data and resource management data, the intelligent RCA performs original alarm data and resource management data association, converts and aggregates data, and forms feature data, finally generates an alarm association knowledge map through the AI mining algorithm and graph model. By detecting association conflicts and visually displaying the alarm association logic and priority, it improves the readability and interaction of RCA rules.

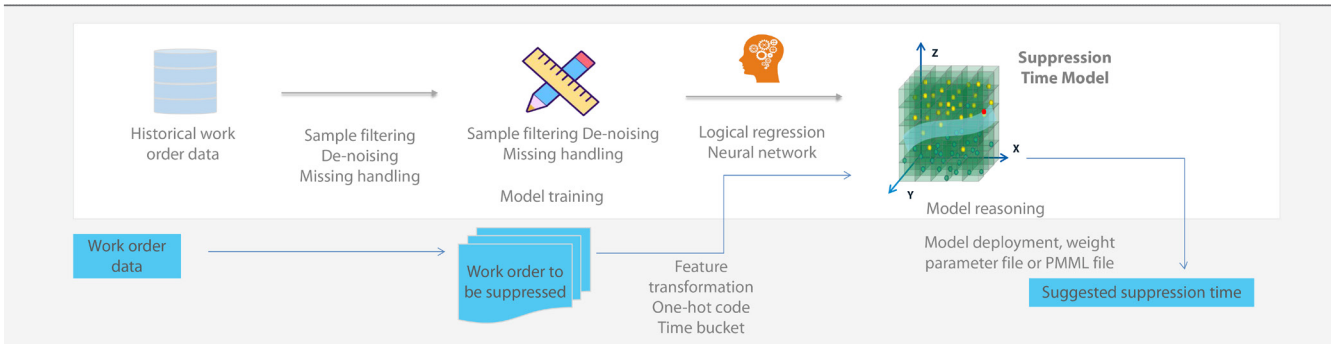
The system builds a knowledge map of alarm association, enhances the AI algorithm, promotes the self-growth of the alarm rule library, iterates the knowledge map through data mining, fully accumulates O&M experience, and improves the alarm compression rate and work order efficiency.



Dispatch suppression: Learn the best dispatch time based on the model to improve dispatch accuracy

The traditional dispatch time delay uses a fixed time, when there are a large number of faults and self-recovery phenomena in the network, which is likely to cause invalid dispatch. The dispatch suppression function uses moving window differential statistics/fitting normal distribution, logistic regression, and neural network algorithms to model historical alarms and work order data, and provide the best dispatch suppression time recommendations.

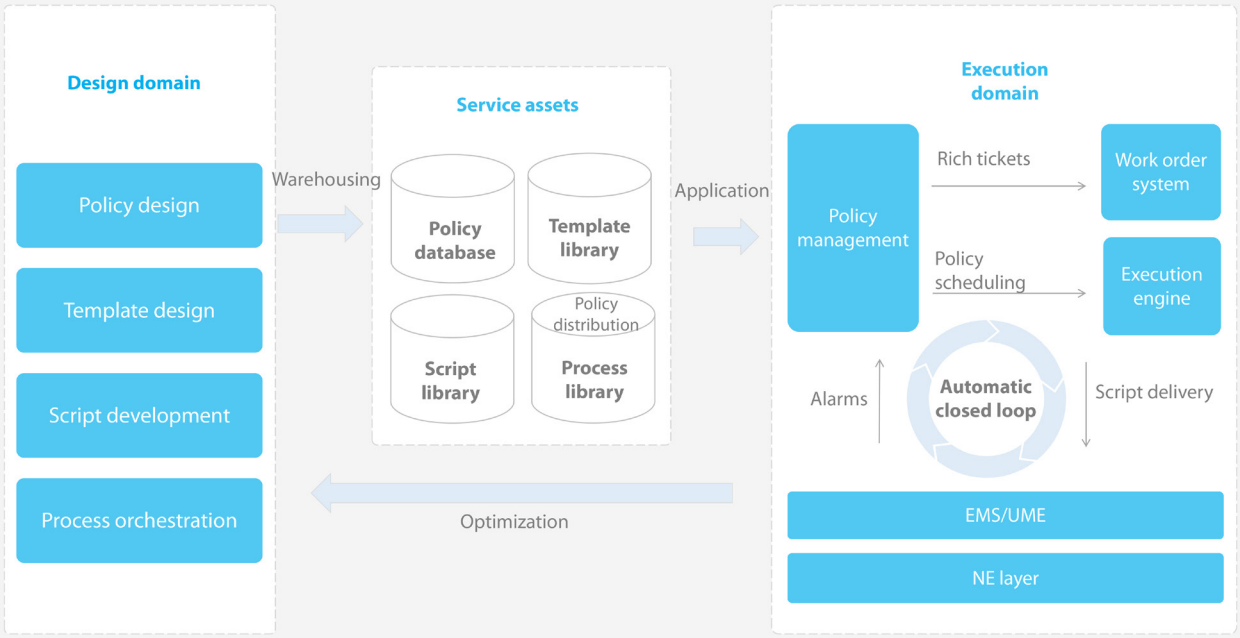
The work order dispatch suppression function can flexibly provide specific work order suppression time, reduce invalid work order dispatch, and effectively improve the accuracy of work order dispatch.



Diagnosis and self-healing: Policy-based automatic diagnosis and recovery, improving troubleshooting efficiency

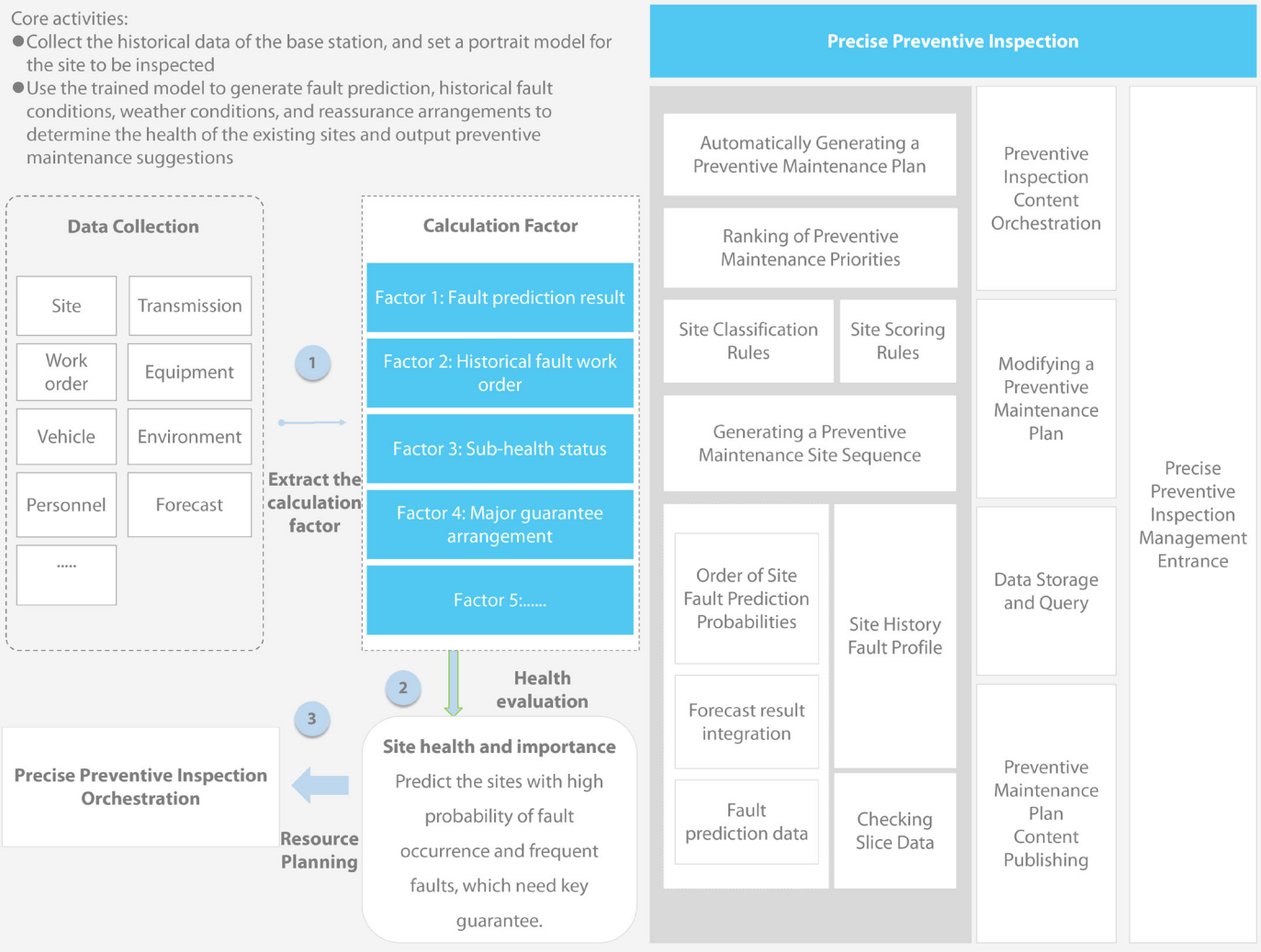
Fault diagnosis and self-healing is a key action of fault pre-processing. Manual fault diagnosis test analysis requires O&M experts to perform on professional network management, which is time consuming, resulting in high MTTR. Through the fault diagnosis model, the expert experience is solidified into an automatic diagnosis script, and the equipment information such as port status, hardware status, software status, and link status is collected to perform automated analysis and diagnosis. The diagnosis result and processing suggestions are enriched in the work order. Furthermore, for some fault scenarios with simple operation, standardized handling, and low risk, fault self-healing action will be performed to quickly eliminate faults.

The system is designed based on the policy center to implement automatic diagnosis and self-healing policies. The global provision module implements instruction interconnection with the EMS, delivers diagnosis and recovery scripts to close the loop.



Precise preventive-maintenance: Utilizing fault prediction and site profiles to improve efficiency of preventive maintenance

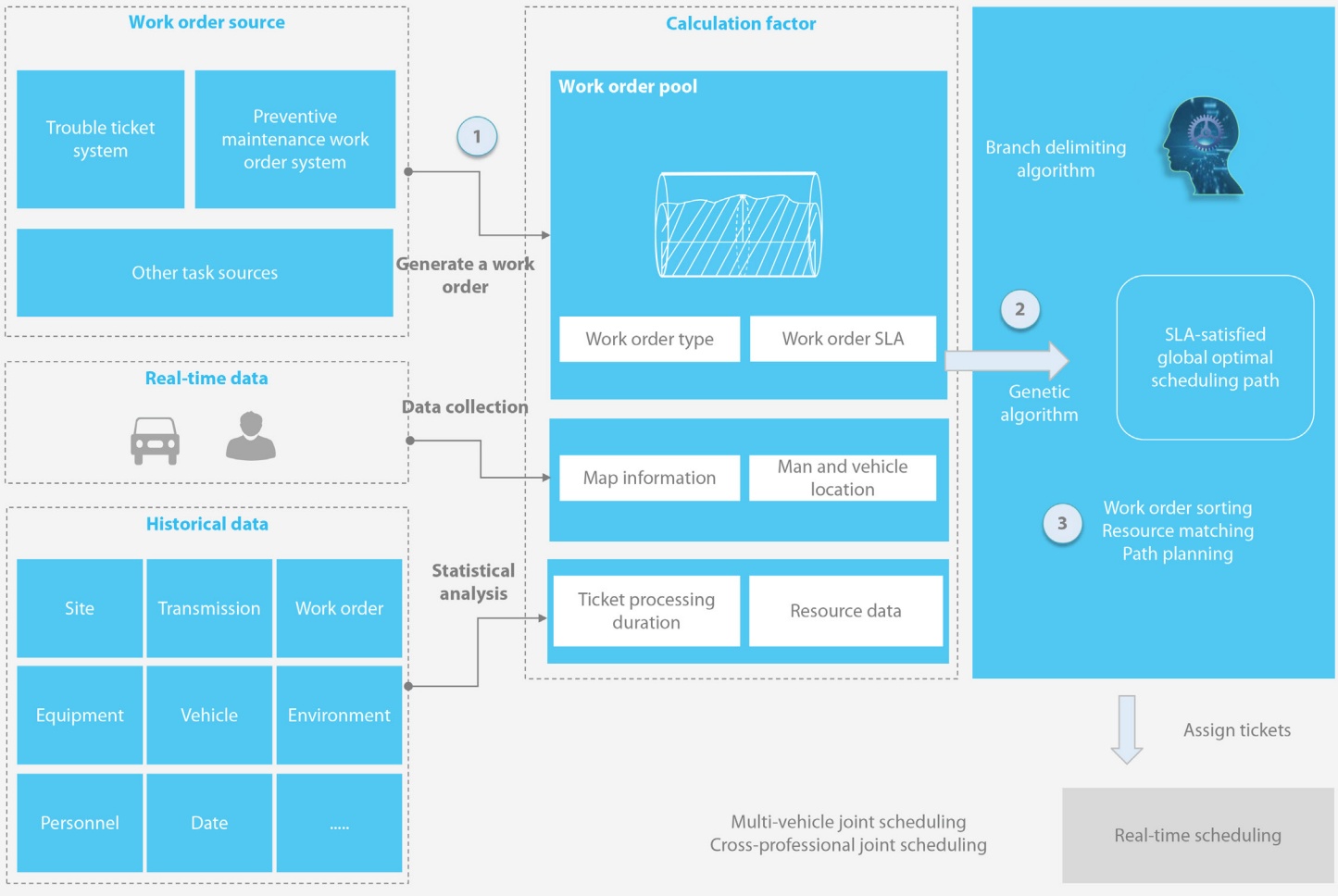
Precise preventive-maintenance firstly applies data management techniques to gather history work orders, network element alarms, trouble tickets, asset, fault prediction results, and then calculates site access priories for all sites. The priorities can be written to evaluated scores, and site access sequence of the preventive maintenance is dynamically adjusted in accordance with the score of each site which is updated day by day. Based on the recommend sequence, preventive maintenance plans are scheduled, and tasks and suggestions are pushed to the apps of field O&M engineers. When the preventive maintenance is finished, using the app to feed back the preventive maintenance result and complete the closed-loop management. In this way, the effectiveness and quality of preventive maintenance can be improved.



Intelligent scheduling: Resource scheduling based on genetic algorithms to improve resource usage efficiency

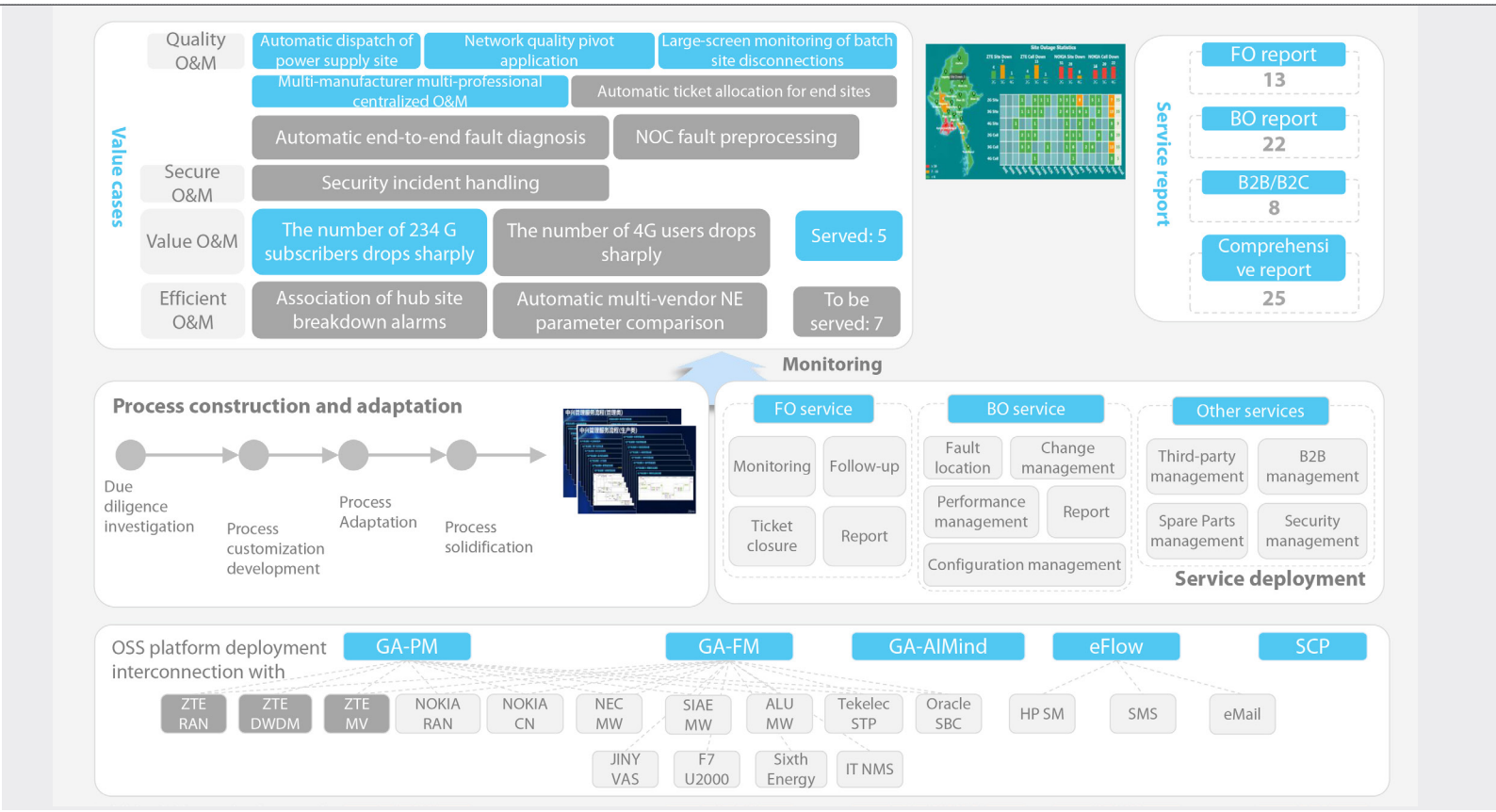
Intelligent scheduling integrates various factors related to scheduling, such as SLA, fault level, traffic conditions, weather, etc., and engages efficient genetic algorithms to dispatch engineers, vehicles, and work orders.

The global optimum scheduled routines that meets the SLAs can be calculated out by utilizing the genetic algorithm, as well as multi-vehicles dispatch or cross-field and joint work cases can be reached. This intelligent scheduling model can greatly reduce invalid paths and improve the utilization of operation and maintenance resources.



Application Case

The services of an overseas operator cover the wireless mobile network, enterprise private line (B2B) and home broadband (B2C). The main mobile network covers 2G, 3G and 4G networks, with the main interfaces of FLM, NOC, spare parts management, network optimization and B2B.



ZTE provides complete NOC service delivery and operation and maintenance management, and assists operators in digital transformation through intelligent network operation and maintenance solutions. The main functions include:

Intelligent RCA: It supports mining of alarm association rules based on knowledge map in multiple scenarios to improve the accuracy of alarm association rules and the efficiency of rule mining by 80%.

Automatic work order: The system dispatches intelligent work orders according to the severity, location and required skill information of the fault. The automatic work order dispatch rate is greater than 85%.

Accurate work order: The system provides work order dispatch delay optimization suggestions through the dynamic work order suppression function to improve the work order dispatch accuracy 10+%.

Fault prediction and precise preventive maintenance: Based on deep learning, the system can predict faults and identify potential network problems in advance, and eliminate them through accurate preventive maintenance.

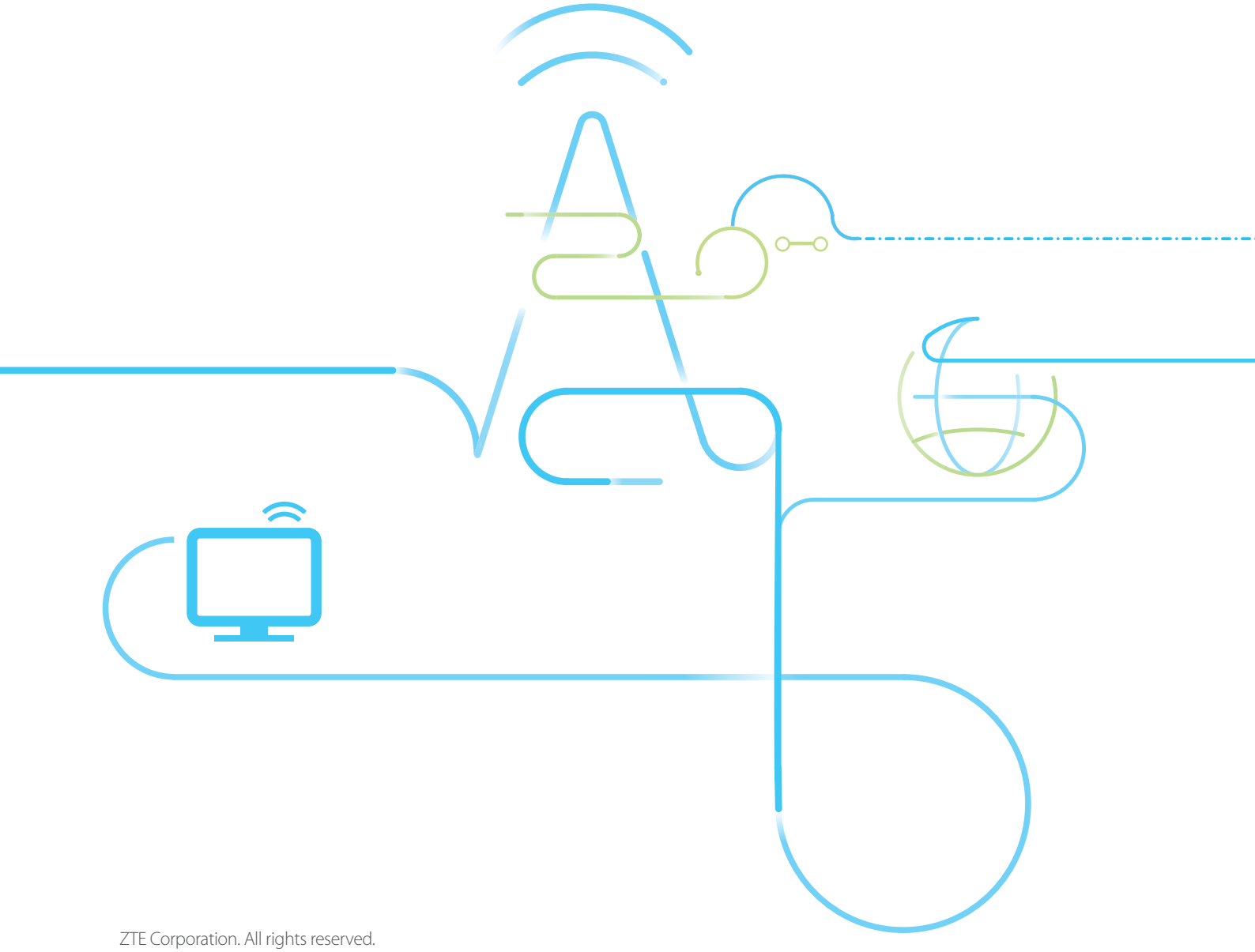
Automatic fault diagnosis and self-healing: For typical faults such as cell out-of-service faults, automatic pre-processing based on intelligent policy centers is implemented.

Work order compression: Through the introduction of automatic and intelligent solution, O&M efficiency has increased by 30%.

Integrated NOC and SOC: Scores the KPIs of the entire network on the global dimension, and the O&M quality can be measurable,visible, manageable in higher CXO level.

Acronyms

Acronyms	Full Name
AI	Artificial Intelligence
API	Application Programming Interface
EMS	Element Management System
FM	Fault Management
GA	Global Assurance
GP	Global Provision
KPI	Key Performance Index
NFV	Network Function Virtualization
NOC	Network Operation Center
OSS	Operation Support System
PM	Performance Management
SLA	Service-Level Agreement
SOC	Service Operation Center
TT	Trouble Ticket



ZTE 中兴通讯股份有限公司 ZTE CORPORATION

NO.55, Hi-tech Road South, ShenZhen,P.R. China Postcode:518057

Website:www.zte.com.cn Tel:+86-755-26770000 Fax:+86-755-26771999