ANL Assessment and evidences of China Mobile on GB1059A

April 2025

Autonomous network level evaluation - RAN Fault Management(1/2)

High-Value Scenario	Cognitive Activity (IAADE)	Service Capability	Weight	Question	Option A	Option B	Option C	Option D
RAN - Fault Management	Intent	Intent-driven	10%	Does the wireless network fault management system have the capability of automatically generating fault management task targets, policies and evaluating the implementation effect based on intent? Note: Based on the specified fault management intent (such as the out-of-service duration), the system determine the fault management targets (such as the proportion of pre-event trouble tickets and fault locating duration) and fault management policy (such as redundancy backup). Fault scenarios include NE disconnection or out-of-service, cell faults, and fronthaul network faults.	The system automatically generates fault management task targets and policies based on intent. Fault management targets and policies need to be manually confirmed. The system automatically evaluates the implementation effect.	The system automatically generates fault management task targets based on predefined rules. Fault management targets and policies need to be manually defined. The effect is manually evaluated after the intent is implemented.	Fault management task targets and policies are manually defined based on expertise. Manually evaluate the effect after the intention is implemented.	
	Awareness	Data collection & Alarm filtering	10%	Does the wireless network fault management system support automatic data collection & alarm filtering in various fault scenarios? Fault scenarios include NE disconnection or out-of-service, cell faults, and fronthaul network faults.	The system can automatically collect data (alarm, configuration, and performance data etc.), associate alarms, and filter alarms.	The system can automatically collect data (alarm, configuration, and performance data etc.), associate alarms, and filter alarms based on manually defined rules	Manually select and use the system to collect data and filter out invalid/redundant alarms.	People use the system to collect data and manually filter out invalid/redundant alarms.
		Fault Prediction	15%	Does the wireless network fault management system support fault prediction in various fault scenarios? Fault scenarios include NE disconnection or out-of-service, cell faults, and fronthaul network faults.	The system can automatically identify potential risks and predict the fault occurrence time based on intelligent models. For example, the system can predict that the fronthaul optical module will be faulty within XX days.	The system can automatically identify potential risks based on intelligent models (intelligent rules), but cannot predict the fault occurrence time.	The system can identify potential risks based on manually defined rules. For example, the system can identify potential risks of fronthaul optical modules based on preset optical power thresholds.	Potential risks need to be manually identified based on expertise.

Autonomous network level evaluation - RAN Fault Management(2/2)

High-Value Scenario	Cognitive Activity (IAADE)	Service Capability	Weight	Question	Option A	Option B	Option C	Option D
RAN - Fault Management	Analysis	Fault identification & Impact analysis	20%	Does the wireless network fault management system support fault identification & fault impact analysis in various fault scenarios? Fault scenarios include NE disconnection or out-of-service, cell faults, and fronthaul network faults.	The system automatically identifies faults and subsequent impact based on intelligent rules.	The system can automatically identify faults and subsequent impact based on manually defined rules, for example, identifying intermittent faults based on a frequency experience threshold and aggregating periodic alarms based on a period threshold.	Faults and impact need to be manually identified based on expertise.	
		Demarcation & Locating	20%	Does the wireless network fault management system support root cause diagnosis and fault locating in various fault scenarios? Fault scenarios include NE disconnection or out-of-service, cell faults, and fronthaul network faults.	The system automatically demarcates and locates faults based on intelligent models	The system automatically demarcates the fault or locates multiple causes based on intelligent diagnosis models. Manual confirmation is required.	The system can demarcate and locate faults based on manually defined rules, such as experience-based fault trees and troubleshooting processes.	Fault diagnosis needs to be manually performed based on expertise.
		Solution generation	10%	Does the wireless network fault management system support generation of fault recovery solutions in various scenarios? Fault scenarios include NE disconnection or out-of-service, cell faults, and fronthaul network faults.	The system automatically generates the optimal recovery or fault rectification solution through intelligent analysis, such as the neighboring cell RF compensation recovery solution.	The system automatically generates multiple possible recovery or rectification solutions, such as the remote recovery solution, neighboring cell RF compensation service recovery solution. Manual confirmation is required.	The recovery solution needs to be manually identified.	
	Decision	Evaluation and decision-making	10%	Does the wireless network fault management system support evaluation and decision-making in various scenarios? Fault scenarios include NE disconnection or out-of-service, cell faults, and fronthaul network faults.	The system automatically evaluates and determines the optimal recovery or fault rectification solution through intelligent analysis, such as the neighboring cell RF compensation recovery solution.	The system automatically evaluates multiple possible recovery or rectification solutions, such as the remote recovery solution, neighboring cell RF compensation service recovery solution Manual confirmation is required	The recovery solution needs to be manually evaluated and decided.	
	Execution	Solution implementation	5%	Does the wireless network fault management system support automatic execution of troubleshooting solutions in various scenarios? Fault scenarios include NE disconnection or out-of-service, cell faults, and fronthaul network faults.	The system can automatically execute instructions.	Humans use the system to execute instructions.	The recovery solution needs to be manually implemented	

Overall

In the ratings of eight autonomous capability for RAN fault management, China Mobile obtained 7”A”s &1“B”, among them, the "intent-driven" capability is currently assessed as “B”.

Service Capability	Weight	Answer	Score
Intent-driven	10%	B	3
Data Collection and Alarm Filtering	10%	A	3. 8
Fault prediction	15%	A	4
Fault Identification and Impact Analysis	20%	A	3.8
Demarcation and locating	20%	A	4
Solution generation	10%	A	4
Evaluation and Decision-Making	10%	A	4
Solution Implementation	5%	A	3. 8
			3.83

Intent-driven

Question

- Does the wireless network fault management system have the capability of automatically generating fault management task targets, policies and evaluating the implementation effect based on intent?
- Note: Based on the specified fault management intent (such as the out-of-service duration), the system determine the fault management targets (such as the proportion of pre-event trouble tickets and fault locating duration) and fault management policy (such as redundancy backup). Fault scenarios include NE disconnection or out-of-service, cell faults, and fronthaul network faults.

Options

Option A	✓ Option B	Option C	Option D
The system automatically generates fault management task targets and policies based on intent. Fault management targets and policies need to be manually confirmed. The system automatically evaluates the implementation effect.	The system automatically generates fault management task targets based on predefined rules. Fault management targets and policies need to be manually defined. The effect is manually evaluated after the intent is implemented.	Fault management task targets and policies are manually defined based on expertise. Manually evaluate the effect after the intention is implemented.	

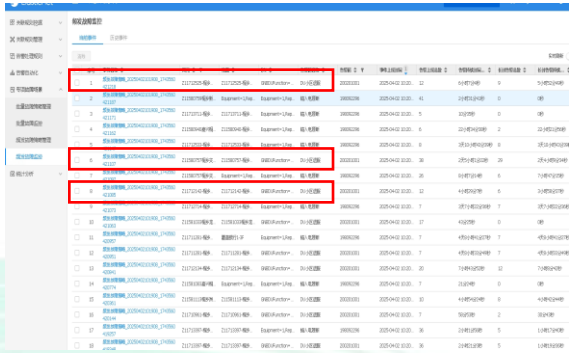
Evidence

In the scenario where a cell is out of service, for example, you can identify intentions based on fault management (maintain the stable operation of network devices), determine management objectives (handle alarms that frequently occur in a high-priority manner), and management policies (if the number of times that an alarm occurs on the same NE within xx consecutive days exceeds xx, an additional "event" is generated to alert maintenance personnel).

Pre-defined planning (if there are more than five pre-defined plans within seven days, an early warning will be given...), and task objectives will be automatically generated.

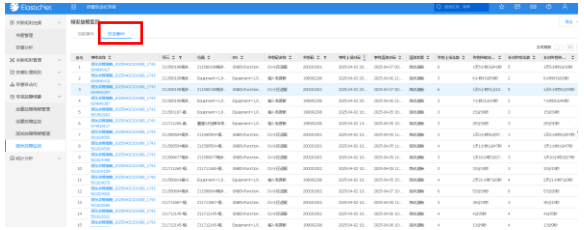
You can select an alarm code to support NE link disconnection or out-of-service, cell faults, and fronthaul network faults.

Automatically generate a task in accordance with the target: Monitor the frequent alarm events that exceed the pre-alarm threshold.



Automatic generation of management policies: Each event has detailed alarm classification analysis and implementation suggestions (management policy).

Manual effect evaluation: Detailed alarm classification analysis and implementation suggestions are provided for each event.



Data Collection and Alarm Filtering

Question

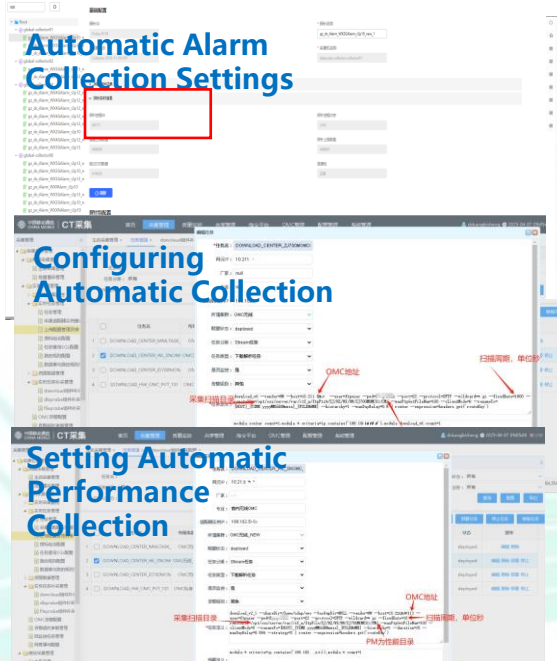
- Does the wireless network fault management system support automatic data collection & alarm filtering in various fault scenarios?
- Fault scenarios include NE disconnection or out-of-service, cell faults, and fronthaul network faults.

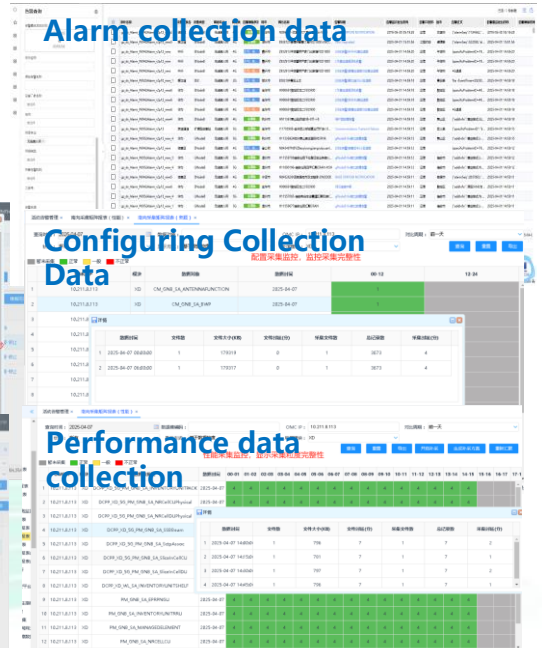
Options

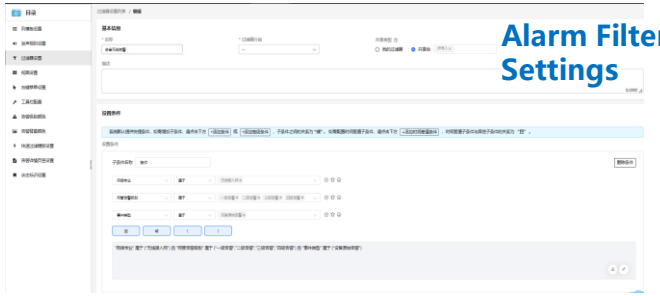
✓ Option A	Option B	Option C	Option D
The system can automatically collect data (alarm, configuration, and performance data etc.), associate alarms, and filter alarms.	The system can automatically collect data (alarm, configuration, and performance data etc.), associate alarms, and filter alarms based on manually defined rules	Manually select and use the system to collect data and filter out invalid/redundant alarms.	People use the system to collect data and manually filter out invalid/redundant alarms.

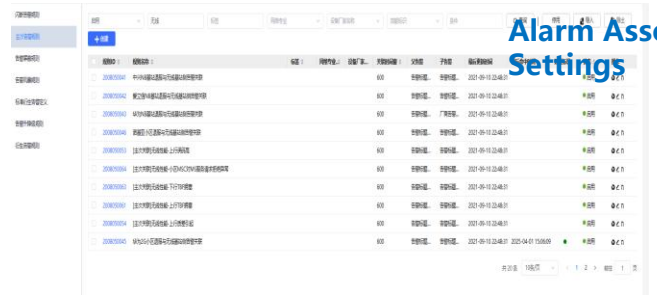
Evidence

- Data collection and association: Automatic collection and association of alarms, configurations, and performance data in different networks and scenarios are implemented based on the fault center collector. The automatic collection ratio is 100%.
- Repeated alarm filtering: Based on the alarm filtering configuration in the fault center, invalid and redundant alarms are automatically filtered in accordance with rules. Automatic filtering proportion 100%.









Fault prediction

Question

- Does the wireless network fault management system support fault prediction in various fault scenarios?
- Fault scenarios include NE disconnection or out-of-service, cell faults, and fronthaul network faults.

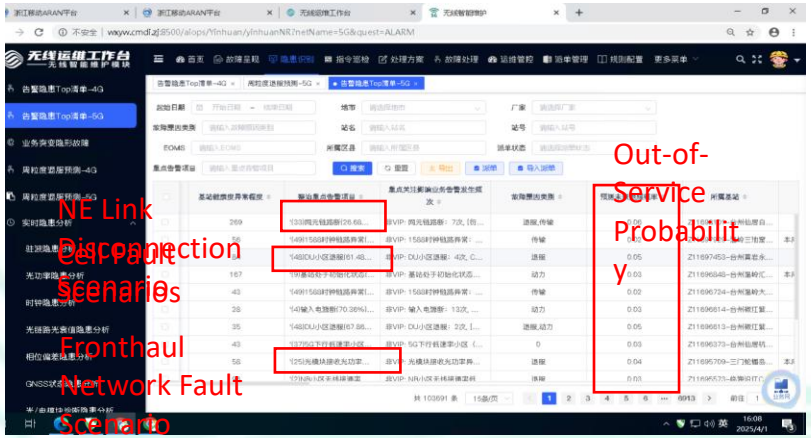
Options

✓ Option A	Option B	Option C	Option D
The system can automatically identify potential risks and predict the fault occurrence time based on intelligent models. For example, the system can predict that the fronthaul optical module will be faulty within XX days.	The system can automatically identify potential risks based on intelligent models (intelligent rules), but cannot predict the fault occurrence time.	The system can identify potential risks based on manually defined rules. For example, the system can identify potential risks of fronthaul optical modules based on preset optical power thresholds.	Potential risks need to be manually identified based on expertise.

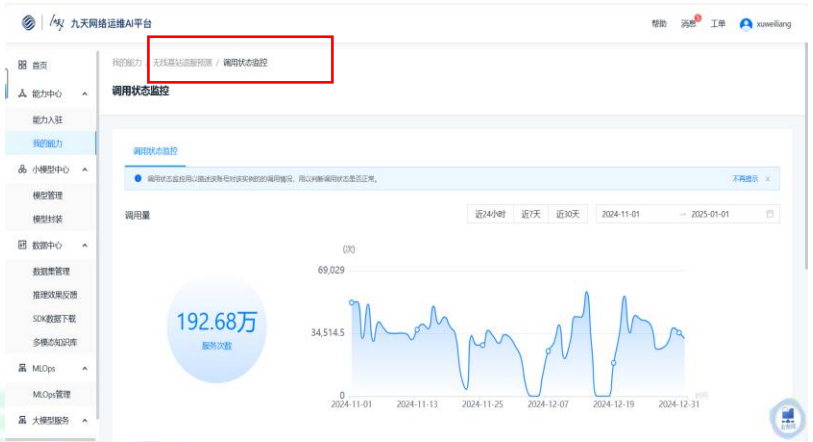
Evidence

The prediction model of the wireless O&M workbench is used to evaluate the out-of-service probability of base stations in the future. Based on the alarms, trouble tickets, and dynamic and environmental supporting data of base stations, and the correlation between historical fault time, fault frequency, trouble tickets, and dynamic and environmental supporting data, the comprehensive analysis is performed to output the out-of-service probability of base stations in a specific future period. The out-of-service prediction accuracy is greater than 95%.

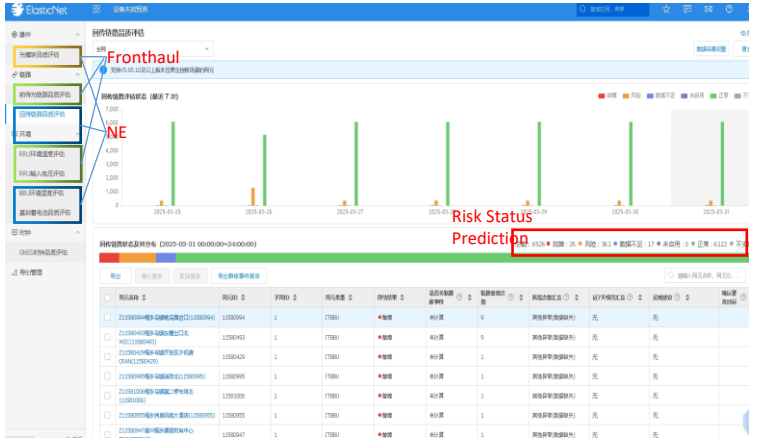
Wireless O&M Workbench



Atomic capability: Large-model-based cell out-of-service prediction



Atomic capability: Small-model-based device failure prediction (NE and fronthaul)



Fault Identification and Impact Analysis

Question

- Does the wireless network fault management system support fault identification & fault impact analysis in various fault scenarios?
- Fault scenarios include NE disconnection or out-of-service, cell faults, and fronthaul network faults.

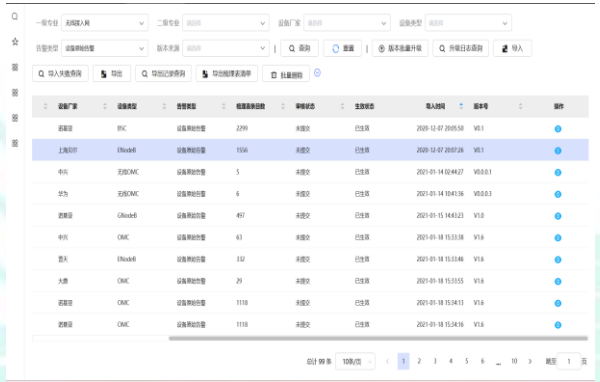
Options

✓ Option A	Option B	Option C	Option D
The system automatically identifies faults and subsequent impact based on intelligent rules.	The system can automatically identify faults and subsequent impact based on manually defined rules, for example, identifying intermittent faults based on a frequency experience threshold and aggregating periodic alarms based on a period threshold.	Faults and impact need to be manually identified based on expertise.	

Evidence

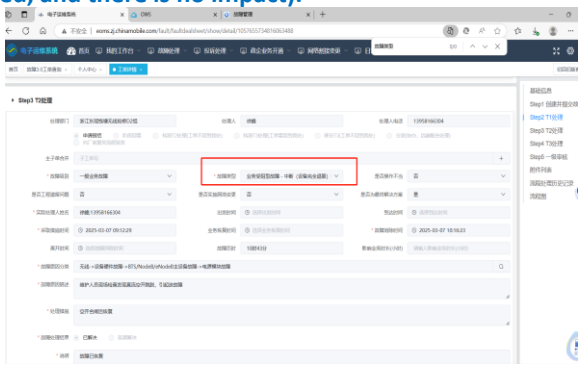
Fault identification: Based on the fault classification list of base stations, analyze the correlation between alarms and base station fault classification, extend the base station fault classification, and output the base station fault identification result (base station out-of-service, cell out-of-service, or performance fault). The fault center identifies faults through intelligent rules, associated resource centers, and performance centers in multiple dimensions. The identification accuracy is 100%.
Fault impact analysis: In accordance with different types of faults and the impact degree, the system automatically outputs the impact of this alarm. For a single-site fault, the system outputs the qualitative results such as all services blocked, some services affected, and no impact, which are displayed in the fault work order. The impact analysis coverage rate 100%, accuracy rate >95%. For more serious batch outage, output more accurate analysis results such as the fault impact scope and the number of users.

The fault center supports the identification of fault types in all fields.

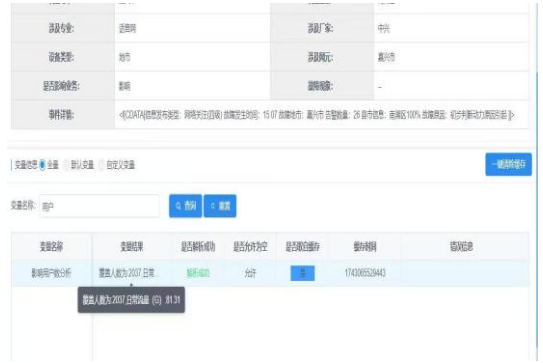


The fault center corresponds to the alarm level in accordance with the alarm situation.

Single-site fault impact analysis: Qualitative analysis (all services are blocked, some services are partially blocked, and there is no impact).



Analyze the impact of out-of-service faults in batches: Analyze the impact of the fault scope and the number of users.



Demarcating and locating

Question

- Does the wireless network fault management system support root cause diagnosis and fault locating in various fault scenarios?
- Fault scenarios include NE disconnection or out-of-service, cell faults, and fronthaul network faults.

Options

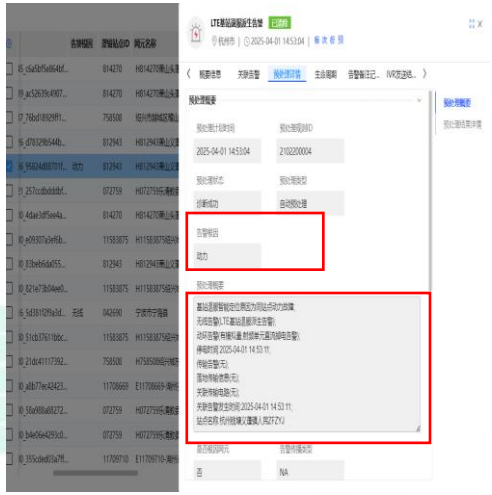
✓ Option A	Option B	Option C	Option D
The system automatically demarcates and locates faults based on intelligent models	The system automatically demarcates the fault or locates multiple causes based on intelligent diagnosis models. Manual confirmation is required.	The system can demarcate and locate faults based on manually defined rules, such as experience-based fault trees and troubleshooting processes..	Fault diagnosis needs to be manually performed based on expertise.Fault diagnosis needs to be performed manually in accordance with professional knowledge.

Evidence

- Cross-domain alarm association delimitation: Based on the large fault intelligent analysis model, this function analyzes the current alarms of base stations, implements the delimitation of wireless, dynamic, and transmission fields, locates the root causes of alarms in scenarios such as NE link disconnection, out-of-service, cell faults, and fronthaul network faults, and achieves the accuracy of >95% delimitation and location.
- Single-domain alarm root cause location: Through the alarm root cause diagnosis function provided by the device manufacturer, based on the manufacturer's alarm implementation mechanism and decision tree, accurate root cause location inside the device is implemented, and the location accuracy is >95%.

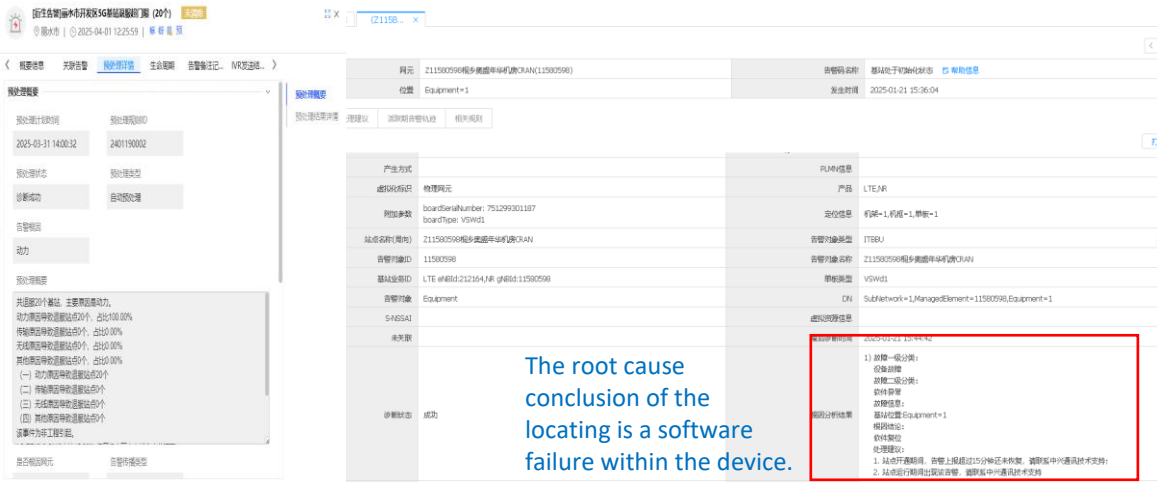
Fault center: Fault Demarcation

Fault center: Single-site fault delimitation and location



Fault center: Fault Demarcating and locating in batches

Precise locating of internal root causes



Solution generation

Question

- Does the wireless network fault management system support generation of fault recovery solutions in various scenarios?
- Fault scenarios include NE disconnection or out-of-service, cell faults, and fronthaul network faults.

Options

✓ Option A	Option B	Option C	Option D
The system automatically generates the optimal recovery or fault rectification solution through intelligent analysis, such as the neighboring cell RF compensation recovery solution.	The system automatically generates multiple possible recovery or rectification solutions, such as the remote recovery solution, neighboring cell RF compensation service recovery solution. Manual confirmation is required.	The recovery solution needs to be manually identified.	

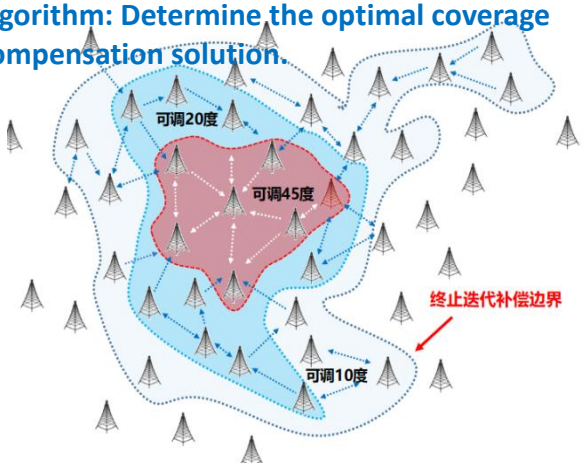
Evidence

- The root cause diagnosis function of the device manufacturer is used to output an alarm solution. Currently, 90% of 5G dispatch alarms are covered, and the solution is valid >90%. Solutions include manual execution (for example, board replacement) and automatic execution (for example, base station reset and RF compensation recovery of neighbor cells).
- Neighbor cell compensation solution: Generates coverage compensation solutions dynamically in real time based on out-of-service alarms, analysis of faulty NEs, power configuration, engineering parameter configuration, and performance indicators of neighbor cells. At the same time, for the problems that may occur during the automatic compensation process of out-of-service sites, the "iterative adjustment convergence" algorithm is innovated to confirm the compensation adjustment range. While guaranteeing the compensation effect, new coverage holes and infinite iterative adjustment problems are avoided to ensure the overall network stability. Solution coverage rate >95%

Manual Solution (Handle the Fiber Manually)

Automatic Solution (Automatic Restoration of Neighbor Cell RF Compensation)

Principle of the coverage compensation algorithm: Determine the optimal coverage compensation solution.



Evaluation and Decision-Making

Question

- Does the wireless network fault management system support evaluation and decision-making in various scenarios?
- Fault scenarios include NE disconnection or out-of-service, cell faults, and fronthaul network faults.

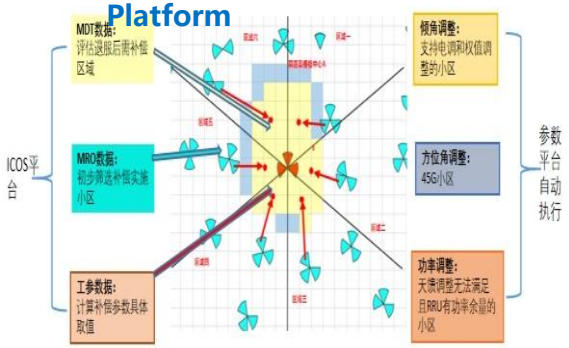
Options

✓ Option A	Option B	Option C	Option D
The system automatically evaluates and determines the optimal recovery or fault rectification solution through intelligent analysis, such as the neighboring cell RF compensation recovery solution..	The system automatically evaluates multiple possible recovery or rectification solutions, such as the remote recovery solution, neighboring cell RF compensation service recovery solution Manual confirmation is required	The recovery solution needs to be manually evaluated and decided.	

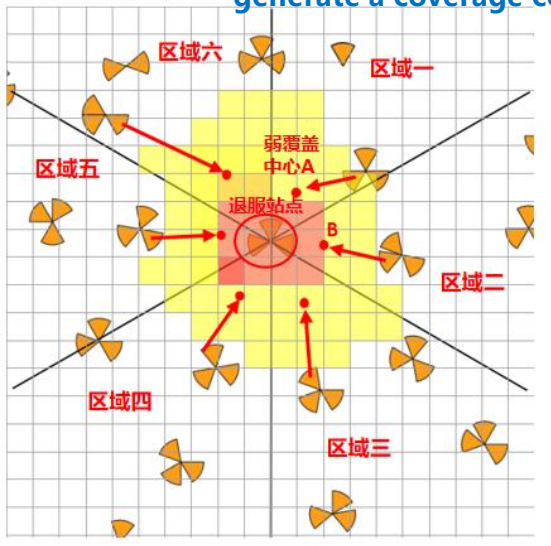
Evidence

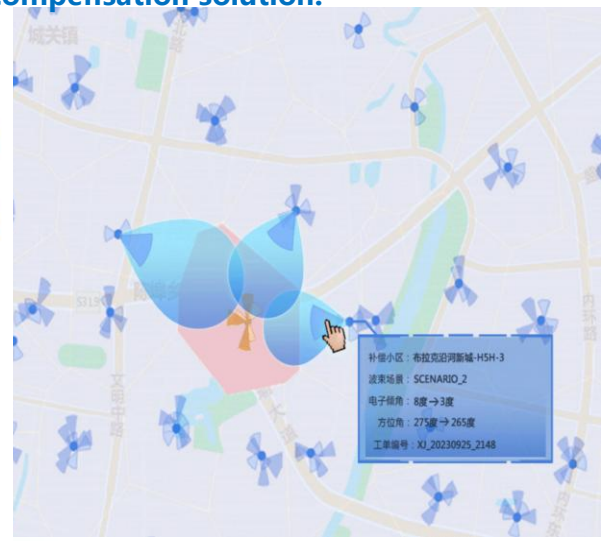
Solution decision-making through the coverage compensation platform: For an out-of-service site, the system obtains the strongest neighbor cell list based on historical MR measurement data, and intelligently analyzes and determines the best neighbor cell beam weight and power adjustment solution. The accuracy of the coverage compensation solution is >95%.

Decision-Making Process of the Coverage Compensation Platform

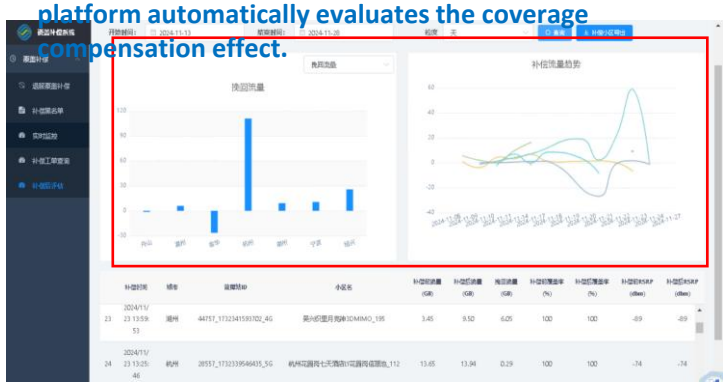


The coverage compensation platform decides to generate a coverage compensation solution.





The rear evaluation module of the coverage compensation platform automatically evaluates the coverage compensation effect.



Coverage compensation traffic recovery evaluation

Solution Implementation

Question

- Does the wireless network fault management system support automatic execution of troubleshooting solutions in various scenarios?
- Fault scenarios include NE disconnection or out-of-service, cell faults, and fronthaul network faults.

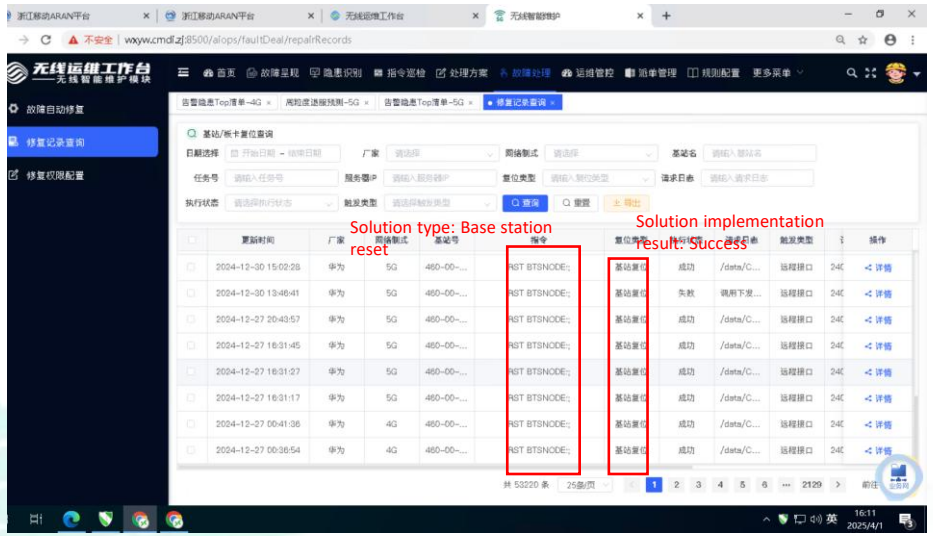
Options

✓ Option A	Option B	Option C	Option D
The system can automatically execute instructions.	Humans use the system to execute instructions.	The recovery solution needs to be manually implemented	

Evidence

- For specified alarms, the AIOPS platform automatically sends instructions to implement self-repair functions such as remote board reset and base station reset, and the success rate of remote repair is >95%.
- Coverage compensation platform: Based on the coverage compensation solution generated through intelligent analysis, after a physical site is out of service, the system automatically delivers and adjusts cell parameters through the parameter platform to recover rescue coverage in the original coverage area of the out-of-service site. The solution implementation automation rate is >95%, and the automatic implementation success rate is >95%.

Example 1: Base Station Reset



Implementation Example 2: Neighbor Cell Compensation

Thank you