

# GB1059D IP Network Fault Management Questionnaire Evidence

China Mobile Group Henan Co., Ltd.

2025.11

## Proportion of tickets for each fault sub-scenario in Henan Mobile's IP/SPN network

Option	Fault Category	Sub-scenarios	Ticket Ratio
The IP/SPN network of Henan Mobile	Physical Port Failure	Sub-scenario-4: Port Failure	23.88%
	Fan Failure/Abnormal Temperature	Sub-scenario-1: Hardware Failure	21.52%
	Optical Power Abnormal	Sub-scenario-3: Optical Module Failure or Optical Power Abnormal	20.78%
	Board Failure	Sub-scenario-1: Hardware Failure	18.98%
	The Bit Error Rate Failure	Sub-scenario-5: High Error Rate	4.48%
	Logical Port Failure	Sub-scenario-4: Port Failure	3.77%
	Device Offline Failure	Sub-scenario-2: Device Offline	2.75%
	Optical Module Failure	SuSub-scenario-3: Optical Module Failure or Optical Power Abnormal	0.16%
	Static L3VPN Service Failure	Sub-scenario-8: VPN Interruption	0.02%
	Tunnel APS Protection Failure	Sub-scenario-7: VPN Degradation	0.01%

The total number of tickets for these fault sub-scenarios accounts for over 90%.

Cognitive Activity (IAADE)	Service Capability	Weight	Question	Answer							Final score	
				Hardware Failure (should include but not limit to board failure, fan failure)	Device Offline	Optical Module Failure or Optical Power Abnormal	Port Failure	High Error Rate	Protocol State Abnormal (should include but not limit to IGP and BGP peer state abnormal, BFD session abnormal)	VPN Degradation		VPN Interruption
				40.50%	2.75%	20.94%	27.65%	4.48%		0.01%		0.02%
Intent	Fault management target formulation	10%	Does the system support automatic generation of fault management targets? Note: 1) Intent could be fault management requirements such as MTTR (mean time to repair) , troubleshooting priority (e.g., emergency restoration in highest priority) , customized troubleshooting preference based on fault impact scope and severity, etc. 2) Fault management target include alarm severity, alarm threshold, alarm aggregation rules, fault notification rules, etc.	A	A	A	A	A	A	A	A	
Awareness	Data Collection	10%	Does the system support automatic collection and aggregation of fault-related indicators \? Note: 1) fault include device offline, physical port down, optical module failure, etc. 2) All types of faults mentioned in 1) and fault-related indicators mentioned in options should be covered when choosing a related option	A	A	A	A	A	A	A	A	
Analysis	Risk identification	10%	Does the system support automatic identification of risks? Note: 1) existing risks include ip configuration conflict, ACL redundancy, receiving frequency weak optical power, etc. 2) potential risks include abnormal memory usage of device, abnormal BGP route number, etc.	A	A	A	A	A	A	A	A	
	Fault identification	10%	Does the system support automatic identification of risks? Note: 1) existing risks include ip configuration conflict, ACL redundancy, receiving frequency weak optical power, etc. 2) potential risks include abnormal memory usage of device, abnormal BGP route number, etc.	A	A	A	A	A	A	A	A	
	Demarcation of faults and risks	20%	Does the system support automatic demarcation of faults and risks?	A	A	A	A	A	A	A	A	
	Locating of faults and risks	15%	Does the system support automatic root cause analysis for network faults and risks?	A	A	A	A	A	A	A	A	
Decision	Generation and evaluation of solutions	15%	Does the system support automatic generation and evaluation of emergency restoration and repair solution? Note: 1) Emergency restoration solution may be compute alternative paths based on service SLA requirement. 2) Repair solution may be repair power supply.	A	A	A	A	A	A	A	A	
Execution	Execution and verification	10%	Does the system support automatic execution and verification?	A	A	A	A	A	A	A	A	

4

# Fault management target formulation

Service capability	Weight	Question	Option A	Option B	Option C	Option D
Fault management target formulation	10%	Does the system support automatic generation of fault management targets? Note: 1) Intent could be fault management requirements such as MTTR (mean time to repair), troubleshooting priority (e.g., emergency restoration in highest priority), customized troubleshooting preference based on fault impact scope and severity, etc. 2) Fault management target include alarm severity, alarm threshold, alarm aggregation rules, fault notification rules, etc	The system supports the input of fault management <b>intent by simplified human-system interaction</b> (e.g., nature language user interface provided by system), system automatically translates the intent into fault management targets	The system supports manual configuration of fault management targets with <b>custom rule-based templates</b> . Manually adjustment and confirmation is needed.	The system generates fault management targets based on predefined template. Manually confirmation is needed.	Manually set fault management targets based on expertise (such as setting alarm severity and classification).

## Example evidence for option A:

1、By inputting fault management intentions through natural language, the system will automatically invoke the corresponding fault diagnosis process.

**Input intention of fault management**  
**Deep thinking**

好的，我需要分析用户的意图，确定它属于哪个预定义的目标。用户的意图是：“帮我诊断5000-聊城台三-2804-聊城台三-ETH-PW APS保护-700M5G不通，请帮我诊断”。

第一个目标是“基础业务网络不通故障”，用户中提到“5000-聊城台三-2804-聊城台三-ETH-PW APS保护-700M5G不通”，并且指定了故障设备。这符合该目标的条件。因此，我将启动该目标的诊断流程。

接下来，“以太网链路故障”是关于以太网链路故障的，用户没有提供具体的设备信息，而是业务不通，所以可能不符合。

第二个目标是“基础业务网络故障”，涉及多个基础业务网络，但用户的意图中提到一个专线业务，所以该目标不适用。

第四个目标是“基础业务网络故障”，需要区域和链路，而用户没有提供这些信息，只是具体业务，因此不适用。

第五个目标是“基础业务网络故障”，用户提到了“5000-聊城台三-2804-聊城台三-ETH-PW APS保护”，这符合该目标的条件。因此，我将启动该目标的诊断流程。

综合来看，用户的意图属于“基础业务网络不通故障”，因此我将启动该目标的诊断流程。

调用“基础业务网络不通故障”思维链，分析过程如下：

**Generate fault diagnosis process**

故障诊断信息

- 查询接入信息
  - 检查项
  - 接入网元: 5000-聊城台三-王岭
  - 接入端口: 3-D3E8F-1
  - 汇聚Vlan: 42
  - 设备Vlan: 1
  - 子网
  - VPN类型: PWE3
  - VPN名称: 5000-聊城台三-2804-聊城台三-ETH-PW APS...
- 查询元状态
  - 元元5000-聊城台三-王岭-3-2804-聊城台三-王岭-3-D3E8F-1 (700M5G)
- 思维链: 接口故障诊断(5000-聊城台三-王岭-3-D3E8F-1(700M5G))
  - 元元5000-聊城台三-王岭-3-D3E8F-1(700M5G)无故障，原因是光纤中断、光模块未插紧或者故障、对端设备接口或者端口关闭。

2、Auto-generating a system-executable fault diagnosis thought chain (CoT).

**Large model compilation fault diagnosis of CoT (Chain-of-Thought)**

The system supports fault management and provides diagnostic CoT for various types of faults. The supported fault CoT includes Port Failure, Hardware Failure, Optical Module Failure, Optical Power Abnormal, Bit Error, Device Offline, VPN Degradation/Interruption, 1588 Clock, DGN, Temperature etc.

3、When a fault occurs, the system automatically takes over the fault ticket, understands the intent of the ticket, automatically loads the corresponding fault diagnosis CoT, performs fault demarcation and localization, and generates a repair solution, thereby realizing the automated disposal of the fault process.

**Statistics on the Number of System-Automatically Handled Faults (Past Month)**

故障总数: 23385 | 自动诊断成功: 21565 | 人工处置: 999

**System Auto-Taken Fault Tickets**

故障时间	故障设备	故障现象	故障原因	故障处理	处理时长	恢复时间
2025-11-22 22:16:41	BD_STATUS	自动诊断成功	未恢复	2025-11-22 22:16:41	0	2025-11-22 22:27:14
2025-11-22 22:15:30	FAN_FAIL	自动诊断成功	未恢复	2025-11-22 22:15:30	0	2025-11-22 22:26:21
2025-11-22 22:15:30	POWER_ABNORMAL	自动诊断成功	已恢复	2025-11-22 22:15:30	0	2025-11-22 22:26:21
2025-11-22 22:14:07	ETH_LOS	自动诊断成功	未恢复	2025-11-22 22:14:07	0	2025-11-22 22:25:32
2025-11-22 22:11:10	ETH_LOS	自动诊断成功	未恢复	2025-11-22 22:11:10	0	2025-11-22 22:22:43
2025-11-22 22:11:20	BD_STATUS	自动诊断成功	已恢复	2025-11-22 22:11:20	0	2025-11-22 22:22:27
2025-11-22 22:11:11	ETH_LOS	自动诊断成功	未恢复	2025-11-22 22:11:11	0	2025-11-22 22:22:27
2025-11-22 22:11:14	ETH_LOS	自动诊断成功	未恢复	2025-11-22 22:11:14	0	2025-11-22 22:22:25
2025-11-22 22:09:11	BD_STATUS	自动诊断成功	未恢复	2025-11-22 22:09:11	0	2025-11-22 22:20:18

故障总数: 23385

92.21% 故障工单自诊断率

0.8min 故障平均诊断时长

2.2h 故障平均恢复时长

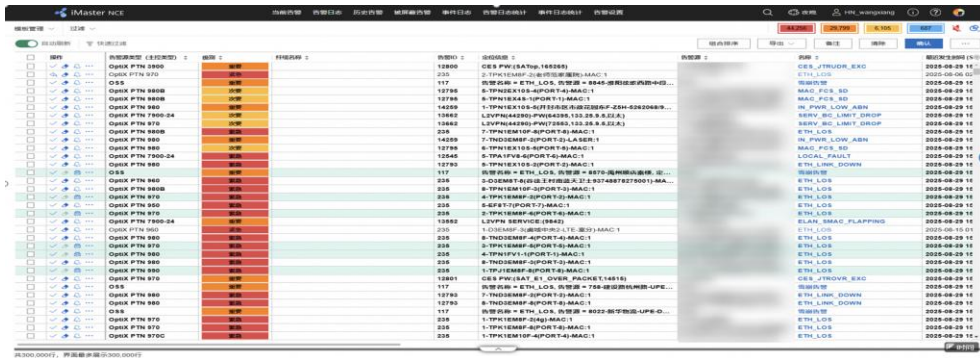
System Automatic Diagnosis-Related Statistics (Past Month): Fault Ticket Automatic Diagnosis Rate, Average Diagnosis Duration, etc.

# Data Collection

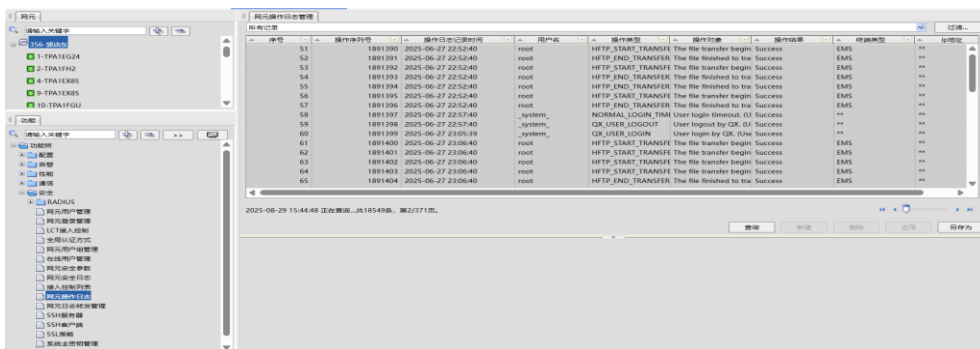
Service capability	Weight	Question	Option A	Option B	Option C	Option D
Data Collection	10%	Does the system support automatic collection of fault-related indicators, including alarms, logs, performance, and OAM data etc.? Note: 1) fault should include but not limit to device offline, physical port down, optical module failure, etc. 2) All types of faults mentioned in 1) and fault-related indicators mentioned in options should be covered when choosing a related option	The system <b>automatically</b> collects fault-related indicators including alarms, logs, performance, and OAM data, detecting service and network status <b>in minutes</b> .	The system <b>automatically</b> collects fault-related indicators including alarms, logs, performance, detecting service and network status <b>within 15 minutes or 24 hours</b> .	The system <b>automatically</b> collects alarms and logs.	

## Example evidence for option A:

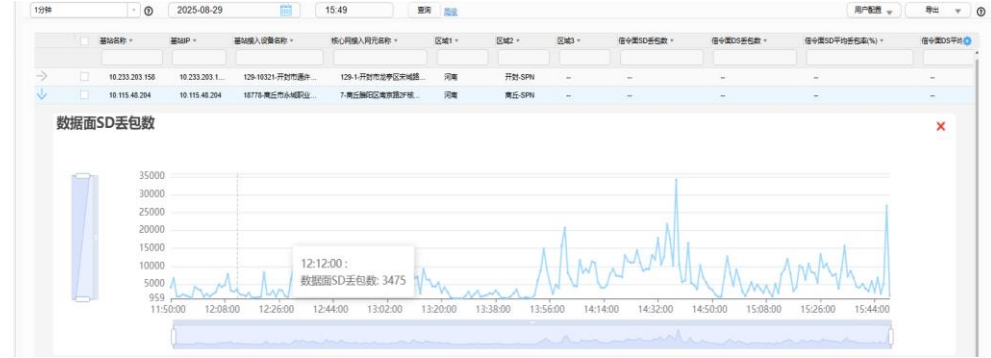
### Real-time Fault & Performance Alarm Management



### Log Management



### Minute-level Performance(Traffic, Packet Loss, Delay, Jitter, etc.)



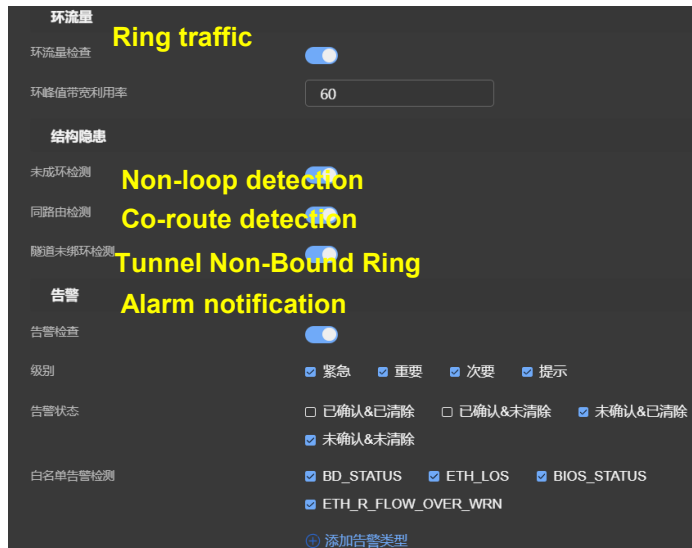
### Service Fault Dashboard(Base station service monitoring)



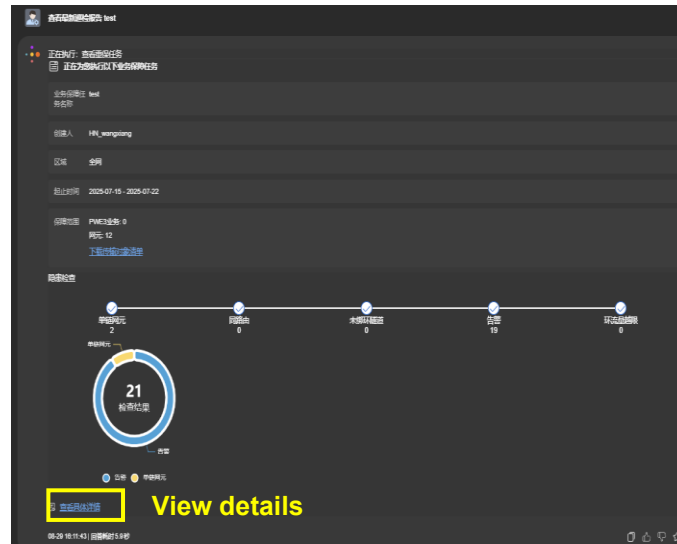
# Risk identification

Service capability	Weight	Question	√ Option A	Option B	Option C	Option D
Risk identification	10%	Does the system support automatic identification of risks? Note: 1) <b>existing risks can be reported in alarm/event</b> , including but not limited to <b>network element and link anomalies</b> , . For example, board temperature, ip configuration conflict, optical module with weak optical power, etc. 2) potential risks can't be reported directly in alarm/event, including but not limited to network element resource and capacity anomalies, network configuration anomalies, and routing anomalies. For example, abnormal memory usage of device, incorrect static route configuration and incorrect BGP configuration, abnormal BGP route number, etc.	The system supports <b>automatic</b> identification of <b>existing risks</b> and <b>prediction of potential risks</b> .	The system supports <b>automatic</b> identification of <b>existing risks</b> .	The system identifies risks based on <b>manually pre-defined rules</b> .	<b>Manually</b> identify risks based on expertise.

## Example evidence for option A:



System supports network risk detection, such as Non-loop detection, Co-route detection, Tunnel Non-Bound Ring detection, Ring traffic threshold-crossing detection, Alarm detection.



Query the network risk check results using natural languages. A risk check result diagram is generated, showing the risk type and quantity.



Risk: Single-Linked NE



Risk: Critical Alarm List

Click View details to view the specific location of the risks. Click Export to generate a check result statistics table in XLS format.

# Fault identification & Impact analysis

Service capability	Weight	Question	√ Option A	Option B	Option C	Option D
Fault identification and impact analysis	10%	Does the system support automatic and intelligent identification of faults? Note: 1) fault should include but not limit to device offline, physical port down, optical module failure, etc. 2) Custom rules include but not limited to scenario specific rules made based on data analysis on alarms, logs, performance and OAM data, etc	The system supports automatic fault identification by <b>intelligent aggregating</b> of multiple data source (alarms, logs, performance data, OAM data, etc.). System provides the impacted services with severity.	The system support automatic fault identification based on <b>custom rules</b> , results need manually confirmation.	The system supports automatic fault identification based on predefined rules, results need manually confirmation.	Manually identify faults based on expertise.

## Example evidence for option A:

**告警列表**

流水号	事件ID	名称	级别	定位信息	事件源名称	发生时间
202630605	14259	IN_PWR_LOW_ABN	次要	500-虚城	500-虚城	2025-06-12 14:0
2026580012	333	CLK_NO_TRACE_MODE	次要	500-虚城	9330-华商银行周集分理处	2025-06-12 13:5
2026611564	12793	ETH_LINK_DOWN	重要	500-虚城	500-虚城	2025-06-12 14:0
202630606	25	IN_PWR_ABN	重要	500-虚城	2-TPA1EG24-6(PORT-6)-LASER1	2025-06-12 14:0
2026599337	100	ETH_LINK_DOWN	重要	500-虚城	9330-华商银行周集分理处	2025-06-12 14:0

Alarm automatically aggregate to identify root & correlated alarms.

**Fault Ticket: Ethernet link of Device A is Loss**

**Root cause: Link interruption**

**Fault diagnosis Process (CoT)**

**Affected Services**

网元名称	端口名称	管理状态	运行状态
5114	1-TPK1EMBF-8(PORT-8)	激活	DOWN

**Query the peer port**

网元	端口	状态	物理名称	物理端口	告警名称	告警发生时间
5114	1-TPK1EMBF-8(PORT-8)	DOWN	ETH_LOS	630304101	2025-11-20 16:59:09	

After receiving the fault ticket, the system automatically diagnoses the root cause of the fault and the affected services.

# Demarcation of faults and risks -1

Service capability	Weight	Question	√ Option A	Option B	Option C	Option D
Demarcation of faults and risks	20%	Does the system support automatic demarcation of faults and risks? Note: 1) Examples of demarcation involve pinpointing the exact roles of malfunctioning routers, like identifying whether they are access routers, aggregation routers, or Autonomous System Boundary Router (ASBR). 2) Custom rules include but not limited to scenario specific rules made based on data analysis on alarms, logs, performance and OAM data, etc	The system <b>automatically</b> demarcates the faults and risks <b>without manual intervention.</b>	The system demarcates the faults and risks based on <b>custom rules</b> , results need <b>manually confirmation.</b>	The system demarcates the faults and risks based on <b>predefined rules</b> , results need <b>manually confirmation.</b>	<b>Manually</b> demarcates the fault and risks based on data such as operation logs and captured packets.

## Example evidence for option A:

After receiving the fault ticket, the system automatically demarcates and locates faults.

### Sub-scenario-1: Hardware Failure

### Sub-scenario-2: Device Offline

### Sub-scenario-3: Optical Module Failure or Optical Power Abnormal

**Fault Ticket: The board is offline or not registered.**

**Root cause: The board is not registered. Repair solution: Remove and reinstall the board.**

**Alarm Check**

告警流水号	告警名称	告警源	发生时间	告警级别	告警详细信息
310621600	BD_STAT...	127-16859-周口鹿邑王皮营镇在基站-HW-SPN800-UPE-DRAN	2025-08-29 16:33:19	紧急	1-TPN2EM10F-故障告警:单板注册失败

**Fault Ticket: Ethernet link of Device A is Loss**

**Root cause: Device B powered off caused the border ports failure**

**Fault diagnosis Process (CoT)**

**Query the peer port**

网元名称	端口	管理状态	业务状态
7066	1-TPN1EMF-S(PORT-5)	激活	DOWN

**Affected Services**

网元	业务名称	业务ID	业务类型	业务状态	业务实例ID
6060	1-TPN1EMF-2.2_L2	L2	60	DOWN	10010
6060	1-TPN1EMF-4.166	L2	66	DOWN	10010
7066	4-INDIRECT-1.1	L2	10	DOWN	6060-7
6060	4-INDIRECT-1.1	L2	66	DOWN	600-62

**Port Diagnosis**

网元	端口	管理状态	业务状态	业务实例ID	业务实例名称
7066	1-TPN1EMF-S(PORT-5)	DOWN	ETH_LOS	337799114	2025-08-30 14:06:19
6067	1-TPN1EMF-7(PORT-7)	DOWN	ETH_LOS	337794909	2025-08-30 14:06:18

**Fault Ticket: Optical Module Failure**

**Root cause: Optical module has been not in place.**

**Alarm Check**

告警流水号	告警名称	告警源	发生时间	告警级别	告警详细信息
337977719	LSR_NO_INSERT	135-2396-市话王-DRAN-工程在建	2025-08-30 14:13:39	紧急	1-TPN1EM10F-10(PORT-10)

# Demarcation of faults and risks -2

Service capability	Weight	Question	√ Option A	Option B	Option C	Option D
Demarcation of faults and risks	20%	Does the system support automatic demarcation of faults and risks? Note: 1) Examples of demarcation involve pinpointing the exact roles of malfunctioning routers, like identifying whether they are access routers, aggregation routers, or Autonomous System Boundary Router (ASBR). 2) Custom rules include but not limited to scenario specific rules made based on data analysis on alarms, logs, performance and OAM data, etc..	The system <b>automatically</b> demarcates the faults and risks <b>without manual intervention</b> .	The system demarcates the faults and risks based on <b>custom rules</b> , results need <b>manually confirmation</b> .	The system demarcates the faults and risks based on <b>predefined rules</b> , results need <b>manually confirmation</b> .	<b>Manually</b> demarcates the fault and risks based on data such as operation logs and captured packets.

## Example evidence for option A:

After receiving the fault ticket, the system automatically demarcates and locates faults.

### Sub-scenario-4: Port Failure

[order\_reply] 查看工单 [SD5B8FARCSF24DA68BFC7A7985374F49]  
故障名称: 设备故障-华为 5030-胡刘 5046-三丁-差分  
故障发现时间: 2025-08-30 05:26:04  
故障对象: 2-TPK1EM8F-1(PORT-1)-MAC1  
诊断详情

#### Fault Ticket: Port failure

调用“端口故障诊断”思维链, 分析过程如下:

**故障原因分析** 完成

原因分析结果汇总  
网元5030-胡刘 端口2-TPK1EM8F-1(PORT-1) 收光无光, 发光正常; 网元5046-三丁-差分 端口2-EG2-1(PORT-1) 收光无光, 发光正常, 原因是光纤中断。

**故障诊断流程** 完成

故障诊断流程  
查看端口影响的业务  
查看端口状态  
网元名称 端口名称 管理状态 运行状态  
5030-胡刘 2-TPK1EM8F-1(PORT-1) 激活 DOWN

#### Local Device and Port Status Check

查看是否存在对端网元掉电  
查看对端端口  
查看端口状态  
网元名称 端口名称 管理状态 运行状态  
5046-三丁-差分 2-EG2-1(PORT-1) 激活 DOWN

查看端口类型  
检查项 结果  
网元名称 5030-胡刘  
端口名称 2-TPK1EM8F-1(PORT-1)  
物理介质 光口

思维链 - 光功率异常故障诊断(5030-胡刘/2-TPK1EM8F-1(PORT-1)) 2025-08-30 13:28:45

#### Local Port Optical Power Anomaly Diagnosis

查看端口光功率信息

端口名称 2-TPK1EM8F-1(PORT-1)  
网元名称 5030-胡刘  
输入光功率状态 无光  
输入光功率 (dBm) -40.0  
最小输入光功率 (dBm) -20.0  
最大输入光功率 (dBm) -8.0  
输出光功率状态 正常  
输出光功率 (dBm) -2.5  
最小输出光功率 (dBm) -6.5  
最大输出光功率 (dBm) 1.5

查看智能光模块数据  
根据端口查链路  
要诊断的端口为: 5030-胡刘/2-TPK1EM8F-1(PORT-1)-5046-三丁-差分/2-EG2-1(PORT-1)  
链路两端光模块功率识别

网元名称	端口名称	查询结果
5030-胡刘	2-TPK1EM8F-1(PORT-1)	性能实例采样数量不足3个, 不满足分析需要...
5046-三丁-差分	2-EG2-1(PORT-1)	正常

思维链 - 光模块异常故障诊断(5030-胡刘/2-TPK1EM8F-1(PORT-1)) 2025-08-30 13:28:25

#### Fault diagnosis of the optical module on the local port

未检测到明确故障原因, 请联系人工处理

查看对端端口  
找到对端端口: 网元5046-三丁-差分, 端口2-EG2-1(PORT-1)

#### Diagnose the optical power of the peer port.

查看端口光功率信息

端口名称 2-EG2-1(PORT-1)  
网元名称 5046-三丁-差分  
输入光功率状态 无光  
输入光功率 (dBm) -60.0  
最小输入光功率 (dBm) -20.0  
最大输入光功率 (dBm) -8.0  
输出光功率状态 正常  
输出光功率 (dBm) -2.6  
最小输出光功率 (dBm) -6.5  
最大输出光功率 (dBm) 1.5

#### Fault diagnosis of the optical module on the peer port

未检测到明确故障原因, 请联系人工处理

结合知识库总结故障原因

网元5030-胡刘 端口2-TPK1EM8F-1(PORT-1) 收光无光, 发光正常; 网元5046-三丁-差分 端口2-EG2-1(PORT-1) 收光无光, 发光正常, 原因是光纤中断。

#### Demarcation Result: Fiber cut detected

#### Fault location result: - Port failure caused by fiber cut



# Locating of faults and risks -1

Service capability	Weight	Question	√ Option A	Option B	Option C	Option D
Locating of faults and risks	15%	Does the system support automatic root cause analysis for network faults and risks? Note: 1) Examples of detailed causes of identified faults, including the smallest replaceable unit, software modules, and ports. 2) Custom rules include but not limited to scenario specific rules made based on data analysis on alarms, logs, performance and OAM data, etc	The system <b>automatically</b> analyzes root cause <b>without manual intervention</b> .	The system provides one or more suspected causes based on <b>custom rules</b> , manually analyze and confirm the root cause.	The system provides cause analysis based on <b>predefined rules</b> , manually analyze and confirm the root cause.	<b>Manually</b> analyze root cause based on expertise.

## Example evidence for option A:

After receiving the fault ticket, the system automatically demarcates and locates faults.

### Sub-scenario-1: Hardware Failure

### Sub-scenario-2: Device Offline

### Sub-scenario-3: Optical Module Failure or Optical Power Abnormal

**Fault Ticket: The board is offline or not registered.**

**Root cause: The board is not registered.**

**Repair solution: Remove and reinstall the board.**

告警流水号	告警名称	告警源	发生时间
310621600	BD_STAT...	127-16859-周口鹿邑王皮溜特在基站-HW-SPN800-UPE-DRAN	2025-08-29 16:33:19

**Fault Ticket: Ethernet link of Device A is Loss**

**Root cause: Device B powered off caused the border ports failure**

**Fault diagnosis Process (CoT)**

网元名称	网元地址	管理状态	业务状态
7006-邦谷公司970	1-TPK1EM0F-S/PORT-5	激活	DOWN

**Port Diagnosis**

**Query the peer port**

**Affected Services**

网元名称	网元地址	管理状态	业务状态
6680-公品物局	10010-北渠路2108-ETH-PW-AP580P-041601	激活	DOWN
6680-公品物局	10010-北渠路2108-ETH-PW-AP580P-041600	激活	DOWN
102-九一街-6680-公品物局	ETH-无环网-105591	激活	DOWN
6680-公品物局	600-中渠路600-ETH-无环网-无源	激活	DOWN

**Port Diagnosis**

网元	网元地址	管理状态	业务状态	业务名称	故障发生时间
7006-邦谷公司970	1-TPK1EM0F-S/PORT-5	DOWN	DOWN	ETH_LOS	2025-08-30 14:06:19
6687-宏量工业孵化器28770	1-TPK1EM0F-7/PORT-7	DOWN	DOWN	ETH_LOS	2025-08-30 14:06:18

**Fault Ticket: Optical Module Failure**

**Root cause: Optical module has been not in place.**

告警流水号	告警名称	告警源	发生时间	告警级别	告警定义信息
337977719	LSR_NO_INSERTED	65-2396-市渠渠王-DRAN-工程在建	2025-08-30 14:13:39	紧急	1-TPK1EM10F-10/PORT-10

**Alarm Check**

# Locating of faults and risks -2

Service capability	Weight	Question	Option A	Option B	Option C	Option D
Locating of faults and risks	15%	Does the system support automatic root cause analysis for network faults and risks? Note: 1) Examples of detailed causes of identified faults, including the smallest replaceable unit, software modules, and ports. 2) Custom rules include but not limited to scenario specific rules made based on data analysis on alarms, logs, performance and OAM data, etc	The system <b>automatically</b> analyzes root cause <b>without manual intervention.</b>	The system provides one or more suspected causes based on <b>custom rules</b> , manually analyze and confirm the root cause.	The system provides cause analysis based on <b>predefined rules</b> , manually analyze and confirm the root cause.	<b>Manually</b> analyze root cause based on expertise.

## Example evidence for option A:

After receiving the fault ticket, the system automatically demarcates and locates faults.  
Sub-scenario-4: Port Failure

**Fault Ticket: Port failure**

Root cause: The fiber optic cable has been severed.

Fault diagnosis Process (CoT)

Local Device and Port Status Check

网元名称	端口名	物理状态	运行状态
5030-胡刘	2-TPK1EM8F-1(PORT-1)	激活	DOWN
5046-三丁-塞分	2-EG2-1(PORT-1)	激活	DOWN

**Local Port Optical Power Anomaly Diagnosis**

端口名	网元名称	输入光功率状态	输入光功率 (dBm)	最小输入光功率 (dBm)	最大输入光功率 (dBm)	输出光功率状态	输出光功率 (dBm)	最小输出光功率 (dBm)	最大输出光功率 (dBm)
2-TPK1EM8F-1(PORT-1)	5030-胡刘	无光	-40.0	-20.0	-8.0	正常	-2.5	-6.5	1.5

**Fault diagnosis of the optical module on the local port**

**Diagnose the optical power of the peer port.**

端口名	网元名称	输入光功率状态	输入光功率 (dBm)	最小输入光功率 (dBm)	最大输入光功率 (dBm)	输出光功率状态	输出光功率 (dBm)	最小输出光功率 (dBm)	最大输出光功率 (dBm)
2-EG2-1(PORT-1)	5046-三丁-塞分	无光	-60.0	-20.0	-8.0	正常	-2.6	-6.5	1.5

**Fault diagnosis of the optical module on the peer port**

**Demarcation Result: Fiber cut detected**

**Fault location result: Port failure caused by fiber cut**

# Locating of faults and risks -3

Service capability	Weight	Question	√ Option A	Option B	Option C	Option D
Locating of faults and risks	15%	Does the system support automatic root cause analysis for network faults and risks? Note: 1) Examples of detailed causes of identified faults, including the smallest replaceable unit, software modules, and ports. 2) Custom rules include but not limited to scenario specific rules made based on data analysis on alarms, logs, performance and OAM data, etc	The system <b>automatically</b> analyzes root cause <b>without manual intervention</b> .	The system provides one or more suspected causes based on <b>custom rules</b> , manually analyze and confirm the root cause.	The system provides cause analysis based on <b>predefined rules</b> , manually analyze and confirm the root cause.	<b>Manually</b> analyze root cause based on expertise.

## Example evidence for option A: After receiving the fault ticket, the system automatically demarcates and locates faults.

**Note:** For sub-scenario 6 (Protocol State Abnormal), no example evidence is provided as there are no corresponding fault tickets in the actual network.

### Sub-scenario-5: High Error Rate / Port Bit Error

**Fault Ticket: Bit Error**

**Root cause: The optical fiber fault caused port bit errors**

### Sub-scenario-7: VPN / Tunnel Degradation

**Fault Ticket: Tunnel A has deteriorated.**

**Root cause: Device B powered off caused the fault**

**Tunnel fault check**

隧道名称	隧道ID	隧道状态	隧道类型	隧道描述
NE_CONN_BK	5573	正常	IPsec	NE_CONN_BK
NE_CONN_LOGIN	5573	正常	IPsec	NE_CONN_LOGIN
ETH_LINK_DOWN	6594	异常	以太网	ETH_LINK_DOWN
ETH_LINK_DOWN	5509	异常	以太网	ETH_LINK_DOWN

**Demarcation result: the fault tunnel path is identified**

**Fault location result: Device B powered off**

### Sub-scenario-8: VPN / Tunnel Interruption

**Fault ticket: VPN interrupted**

**Root cause: The tunnel has been disconnected.**

**Port Fault Diagnosis**

端口名称	角色	端口状态	自检状态
10027	66P	10027	11015
10027	11015	11015	10027

**Tunnel fault check**

**Regional Network Element Out-of-Management Fault Diagnosis**

# Generation and evaluation of solutions -1

Service capability	Weight	Question	√ Option A	Option B	Option C	Option D
Generation and evaluation of solutions	15%	Does the system support automatic generation and evaluation of emergency restoration and repair solution? Note: 1) Emergency restoration solution may be compute alternative paths based on service SLA requirement. 2) Repair solution may be repair power supply.	The system <b>automatically generates</b> emergency restoration and repair solutions. The system <b>automatically make decision</b> on the alternative solutions based on <b>evaluation through simulation</b> .	The system <b>automatically generates</b> emergency restoration and repair solutions. <b>Manually</b> make decision on the alternative solutions.	The system gives emergency restoration <b>suggestions. Manually</b> formulate solutions and make decision.	<b>Manually</b> analyze and evaluate emergency restoration solutions based on system-collected service data.

## Example evidence for option A: After receiving the fault ticket, the system automatically generates emergency restoration and repair solutions.

The system automatically generates an emergency repair solution based on information such as the fault cause and location. The repair solution includes capabilities for two phases:

Phase 1: For faults that the system can automatically repair, it calculates alternative paths to restore services (refer to Fault Sub-scenario 8: VPN/Tunnel Interruption).

Phase 2: For faults requiring on-site manual handling, the system provides a detailed repair plan to guide maintenance personnel in conducting accurate on-site operations, thereby improving on-site work efficiency.

### Auto-takeover Fault Ticket, Localization & Repair Solution Generation

**Statistics on the Number of System-Automatically Handled Faults (Past Month)**

故障列表

故障ID	故障名称	故障类型	故障时间	故障地点	故障状态	故障解决时间	故障解决人
2025-08-22	自动断流成功	未修复	2025-08-22 14:06:56	BD_STATUS	0	2025-08-22 14:16:40	2025-08-22 22:21:14
2025-08-22	自动断流成功	未修复	2025-08-22 14:06:46	FAN_FAIL	0	2025-08-22 14:15:07	2025-08-22 22:26:21
2025-08-22	自动断流成功	已修复	2025-08-22 14:06:46	POWER_ABNORMAL	0	2025-08-22 14:15:33	2025-08-22 22:26:21
2025-08-22	自动断流成功	未修复	2025-08-22 14:06:40	ETH_LOS	0	2025-08-22 14:14:07	2025-08-22 22:25:32
2025-08-22	自动断流成功	未修复	2025-08-22 14:06:39	ETH_LOS	0	2025-08-22 14:11:13	2025-08-22 22:22:40
2025-08-22	自动断流成功	已修复	2025-08-22 14:06:30	BD_STATUS	0	2025-08-22 14:11:23	2025-08-22 22:22:27
2025-08-22	自动断流成功	未修复	2025-08-22 14:06:32	ETH_LOS	0	2025-08-22 14:11:12	2025-08-22 22:22:27
2025-08-22	自动断流成功	未修复	2025-08-22 14:06:31	ETH_LOS	0	2025-08-22 14:11:14	2025-08-22 22:22:26
2025-08-22	自动断流成功	未修复	2025-08-22 14:06:30	BD_STATUS	0	2025-08-22 14:11:09	2025-08-22 22:22:26

**System Auto-Taken Fault Tickets (Past Month)**

### Sub-scenario-1: Hardware Failure

**Repair solution: Remove and reinstall the board.**

故障诊断流程

根据告警流水查看告警信息

告警流水号	告警名称	告警源	发生时间
310621600	BD_STAT...	127-16859-周口唐王皮蛋村在基站-HW-SPN980B-UPE-DRAN	2025-08-29 16:33:19

故障原因分析

网元127-16859-周口唐王皮蛋村在基站-HW-SPN980B-UPE-DRAN的单板7-TPN2EM10F存在未注册故障，需检查单板物理连接状态、电源供应及硬件是否正常。建议重新插拔单板或联系设备供应商进行硬件检测。

### Sub-scenario-2: Device Offline

**Repair solution: Repair the power module of the device and power it on.**

故障原因分析

网元名称: 7086-华信公司570

网元名称	单板	故障状态	运行状态
7086-华信公司570	1-TPK1EMF-S-PORT-S	激活	DOWN

故障原因分析

网元127-16859-周口唐王皮蛋村在基站-HW-SPN980B-UPE-DRAN的单板7-TPN2EM10F存在未注册故障，建议检查单板与设备的物理连接状态、电源供应是否正常，确认单板启动是否加载成功，或尝试通过网管系统重新注册该单板。

### Sub-scenario-3: Optical Module Failure or Optical Power Abnormal

**Repair solution: Check and ensure that the optical module is correctly installed in place.**

故障原因分析

网元名称: 135-2396-布衣堡王-DRAN-工程在理

告警流水号	告警名称	告警源	发生时间	告警级别	告警定级总结
337977719	LSR_NO_FITED	135-2396-布衣堡王-DRAN-工程在理	2025-08-30 14:13:39	紧急	1-TPK1EMF-10(PORT-10)

故障原因分析

故障原因为光模块不在位。

Click to retrospective ticket diagnosis details (including auto-generated repair solution)

# Generation and evaluation of solutions -2

Service capability	Weight	Question	√ Option A	Option B	Option C	Option D
Generation and evaluation of solutions	15%	Does the system support automatic generation and evaluation of emergency restoration and repair solution? Note: 1) Emergency restoration solution may be compute alternative paths based on service SLA requirement. 2) Repair solution may be repair power supply.	The system <b>automatically generates</b> emergency restoration and repair solutions. The system <b>automatically make decision</b> on the alternative solutions based on <b>evaluation through simulation</b> .	The system <b>automatically generates</b> emergency restoration and repair solutions. <b>Manually</b> make decision on the alternative solutions.	The system gives emergency restoration <b>suggestions. Manually</b> formulate solutions and make decision.	<b>Manually</b> analyze and evaluate emergency restoration solutions based on system-collected service data.

## Example evidence for option A: After receiving the fault ticket, the system automatically generates emergency restoration and repair solutions.

The system automatically generates an emergency repair solution based on information such as the fault cause and location. The repair solution includes capabilities for two phases:

Phase 1: For faults that the system can automatically repair, it calculates alternative paths to restore services (refer to Fault Sub-scenario 8: VPN/Tunnel Interruption).

Phase 2: For faults requiring on-site manual handling, the system provides a detailed repair plan to guide maintenance personnel in conducting accurate on-site operations, thereby improving on-site work efficiency.

**Note:** For sub-scenario 6 (Protocol State Abnormal), no example evidence is provided as there are no corresponding fault tickets in the actual network.

### Sub-scenario-4: Port Failure

**Repair solution: The fiber optic cable has been interrupted and needs to be replaced.**

网元名称	端口	管理状态	运行状态
5030-捌捌	2-TPK1EM8F-1(PORT-1)	激活	DOWN
5046-三丁-壹分	2-EG2-1(PORT-1)	激活	DOWN

### Sub-scenario-5: High Error Rate / Port Bit Error

**Repair solution: Check the fiber optic cable and optical module.**

网元名称	端口	管理状态	运行状态
5030-捌捌	2-TPK1EM8F-1(PORT-1)	激活	DOWN
5046-三丁-壹分	2-EG2-1(PORT-1)	激活	DOWN

### Sub-scenario-7: VPN / Tunnel Degradation

**Repair solution: Repair the power module of the device and power it on.**

网元名称	管理状态	运行状态
5572-壹伍伍-贰-壹-ABPTN3900	DOWN	DOWN
5573-壹伍伍-贰-壹-ABPTN3900	DOWN	DOWN
6094-壹壹	DOWN	DOWN
5509-壹伍伍-贰-壹-ABPTN3900	DOWN	DOWN

# Generation and evaluation of solutions -3

Service capability	Weight	Question	√ Option A	Option B	Option C	Option D
Generation and evaluation of solutions	15%	Does the system support automatic generation and evaluation of emergency restoration and repair solution? Note: 1) Emergency restoration solution may be compute alternative paths based on service SLA requirement. 2) Repair solution may be repair power supply.	The system <b>automatically generates</b> emergency restoration and repair solutions. The system <b>automatically make decision</b> on the alternative solutions based on <b>evaluation through simulation</b> .	The system <b>automatically generates</b> emergency restoration and repair solutions. <b>Manually</b> make decision on the alternative solutions.	The system gives emergency restoration <b>suggestions. Manually</b> formulate solutions and make decision.	<b>Manually</b> analyze and evaluate emergency restoration solutions based on system-collected service data.

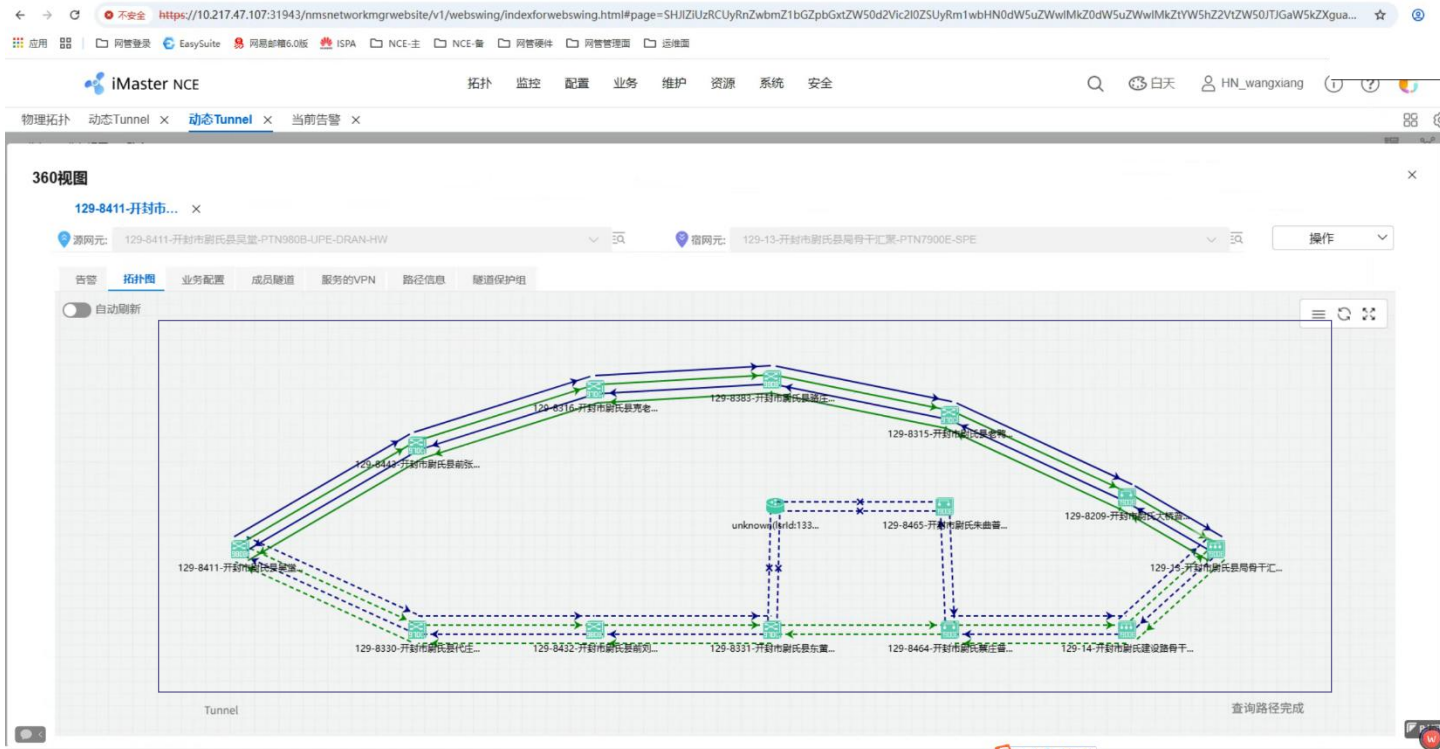
**Example evidence for option A: After receiving the fault ticket, the system automatically generates emergency restoration and repair solutions.**

**Note: For fault sub-scenario 8 (VPN/Tunnel Interruption), the system's emergency recovery includes two phases of capabilities:**

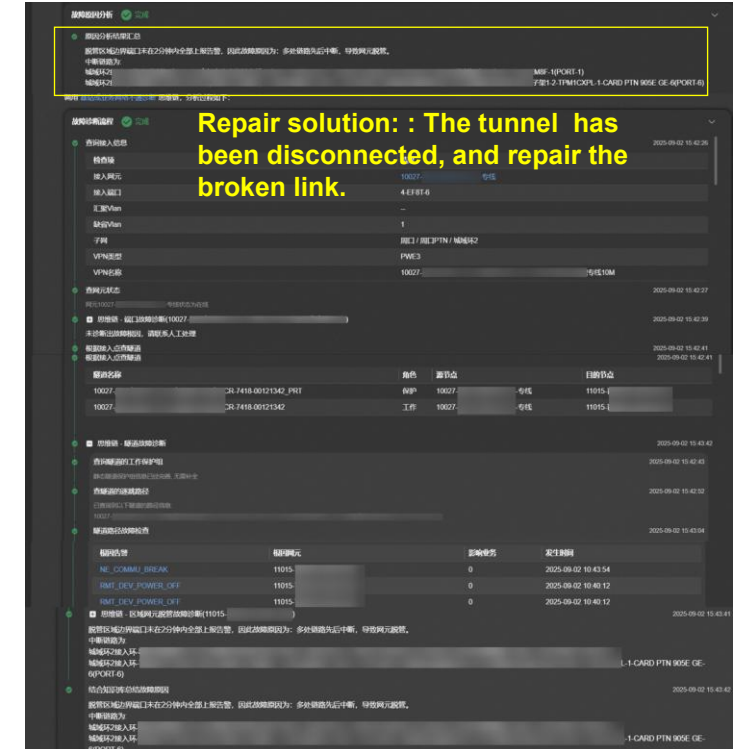
Phase 1: The system automatically generates an emergency recovery plan for the fault and calculates alternative paths to restore services.

Phase 2: For specific faulty links, the system further identifies the cause of the fault and provides a repair solution, supporting maintenance personnel to handle the issue on-site.

## Sub-scenario-8 VPN / Tunnel Interruption: Phase 1: Automatically calculates alternative paths to restore services



## Phase 2: Further identify the root cause of the faulty link and provide a solution for on-site repair.



# Execution and verification -1

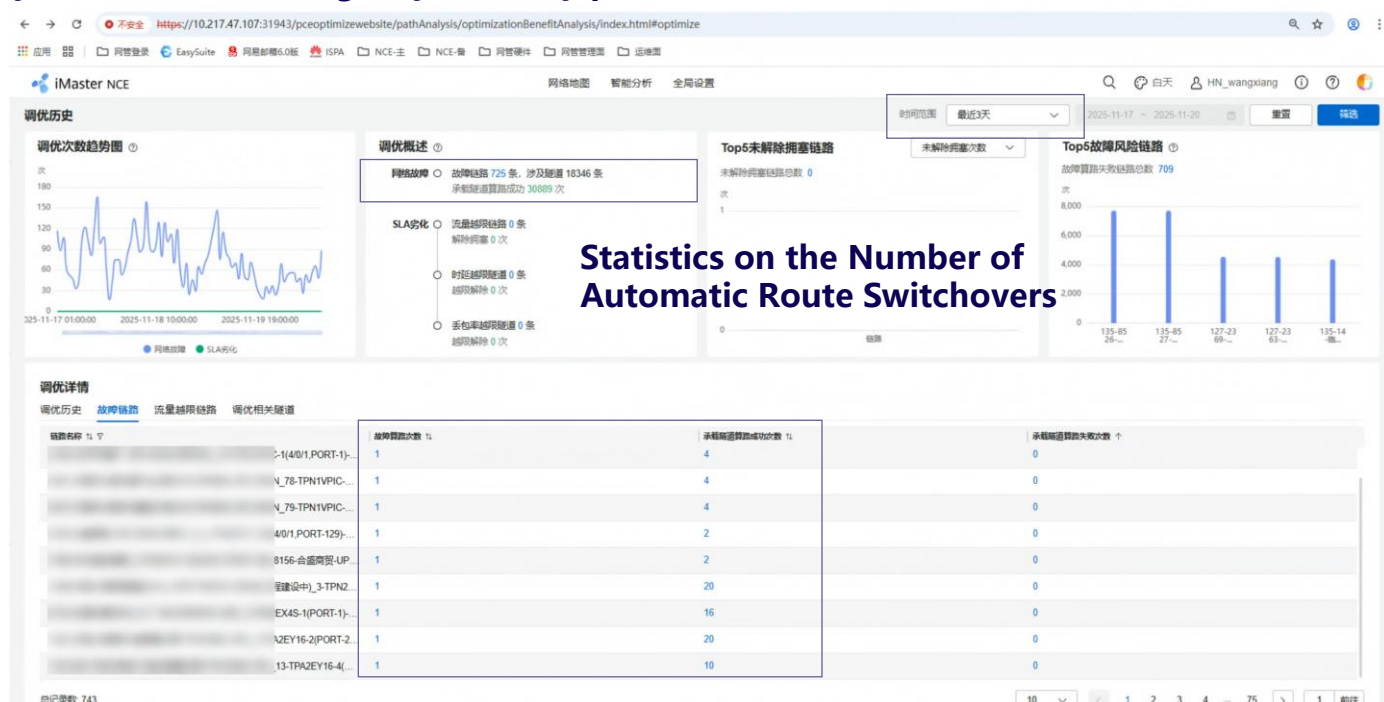
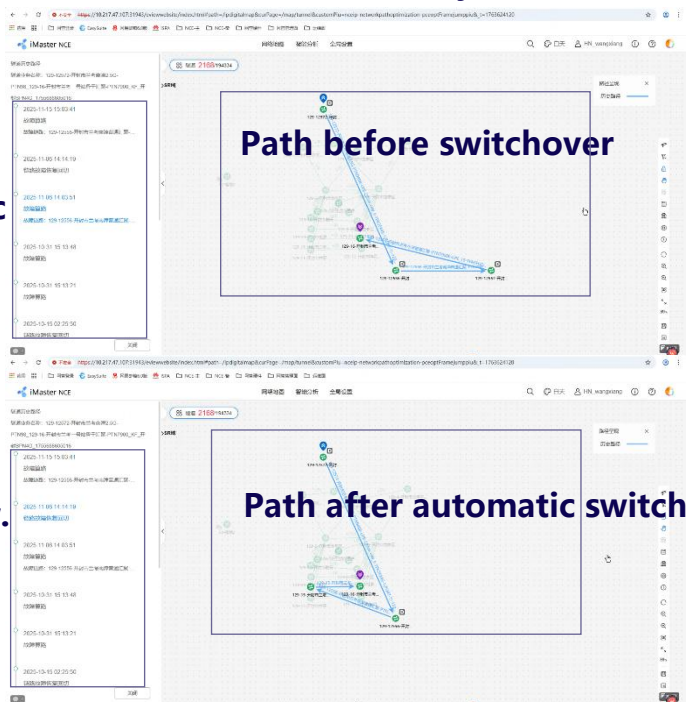
Service capability	Weight	Question	√ Option A	Option B	Option C	Option D
Execution and verification	10%	Does the system support automatic execution and verification? Does the system support assistance for on-site engineers?	1) The system supports <b>automatic execution and verification</b> of emergency restoration and repair solution. (Automatic repair excludes the faults that on-site handling is necessary, such as power supply failure, board fault, fiber cut). 2) The system support intelligent on-site instruction and efficient information query based on simplified human-system interaction.	1)The system supports <b>automatic execution</b> of emergency restoration and repair solution. <b>Manual verification</b> is needed. 2)The on-site handling are assisted by tool.	The system support <b>automatic</b> execution of emergency restoration. Manually execute repair solution. <b>Manually verify</b> by analyzing system data (e.g., alarms)	

## Example evidence for option A:

Scenario 1: For faults that can be automatically repaired by the system, the system automatically executes emergency plans to restore services and achieve service recovery.  
 Scenario 2: For faults requiring on-site manual intervention, frontline maintenance personnel can use the mobile O&M app to perform simplified human-system interaction during site visits. They can intelligently query fault work order diagnosis information, alarm status, optical power indicators, and other data on-site, enabling self-service data access.

### Scenario 1: The system automatically executes the emergency recovery plan to restore services.

Automatic route switching history during failures, records traceable for review.



Statistics on the Number of Automatic Route Switchovers

# Execution and verification -2

Service capability	Weight	Question	√ Option A	Option B	Option C	Option D
Execution and verification	10%	Does the system support automatic execution and verification? Does the system support assistance for on-site engineers?	1) The system supports <b>automatic execution and verification</b> of emergency restoration and repair solution. (Automatic repair excludes the faults that on-site handling is necessary, such as power supply failure, board fault, fiber cut). 2) The system support intelligent on-site instruction and efficient information query based on simplified human-system interaction.	1)The system supports <b>automatic execution</b> of emergency restoration and repair solution. <b>Manual verification</b> is needed. 2)The on-site handling are assisted by tool.	The system support <b>automatic</b> execution of emergency restoration. Manually execute repair solution. <b>Manually verify</b> by analyzing system data (e.g., alarms)	

## Example evidence for option A:

Scenario 1: For faults that can be automatically repaired by the system, the system automatically executes emergency plans to restore services and achieve service recovery.

Scenario 2: For faults requiring on-site manual intervention, frontline maintenance personnel can use the mobile O&M app to perform simplified human-system interaction during site visits. They can intelligently query fault work order diagnosis information, alarm status, optical power indicators, and other data on-site, enabling self-service data access.

## Scenario 2: Intelligent On-Site AI Assistant: Querying Fault Diagnosis Information, etc.

**fault ticket**

标题: 2025-09-10 09:33:50郑州市4923-汽车西站北-UPE-DRAN-郑州中原发生SPN设备故障(板卡故障)

**Faulty Network Element**

**Querying the Optical Power of the Port**

对端	Rx	Tx
11-26d8-UPE-郑州中原区	3.5dBm	4.3dBm
17-TPA1FV8-3(PORT-3)	3.7dBm	4.3dBm
4923-UPE-DRAN-郑州中原	5.4dBm	4.1dBm
3-TPN1FV1-1(PORT-1)	4.1dBm	4.8dBm

**Querying the Port Status**

当前端口	槽位	端口名称	端口类型	介质类型	端口工作模式	端口工作层级	管理状态	运行状态	TAG标识
槽位13-端口24	13	TPA3EG24-24(PORT-24)	GigabitEthernet	光纤	自协商	三层端口(网络侧)	启用	Down	TagAware

**Repair solution**

故障名称: 板卡故障

故障设备: 4923-UPE-DRAN-郑州中原(OptiX PTN 980)

修复建议: 1. 确认告警槽位。2. 如果单板在位, 则更换故障单板, 查看告警是否消除。3. 如果单板不在位, 则插入单板, 查看告警是否消除。4. 如果上电后单板仍然不注册, 则更换该单板, 查看告警是否消除。5. 如果告警未消除, 请联系华为工程师。

**Efficient on-site information inquiry: Querying optical power, faults, network element locations, etc.**

**Thank you**