



中華電信  
Chunghwa Telecom

# Chunghwa Telecom: IP Network Quality Optimization Level Assessment

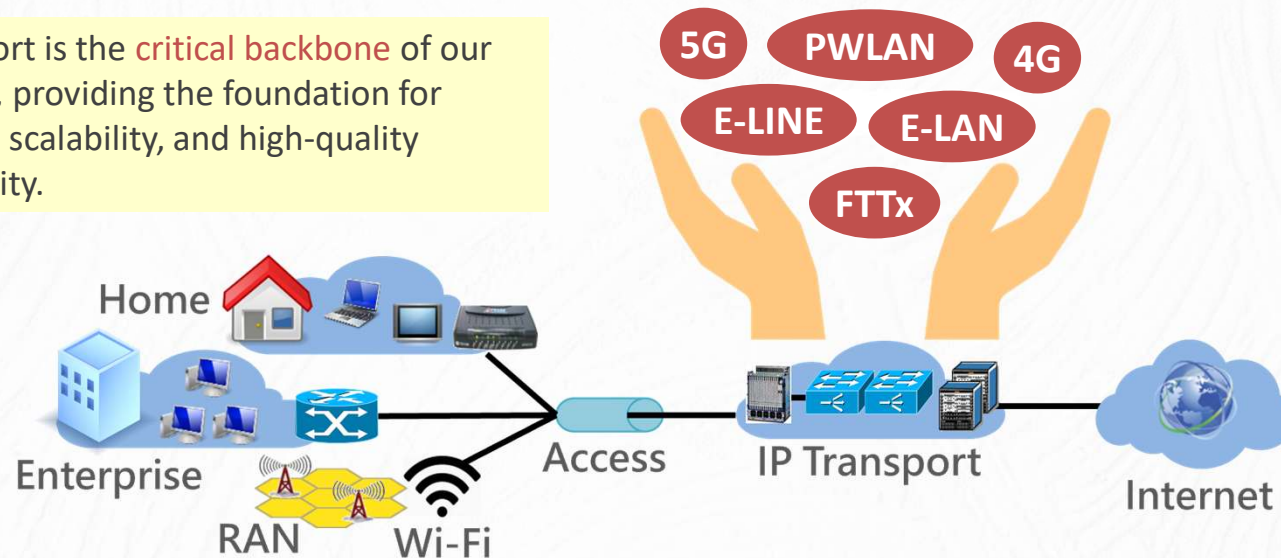
ANLET: [GB1059C v1.1.0](#)

# Chunghwa Telecom's IP Network and Service Portfolio

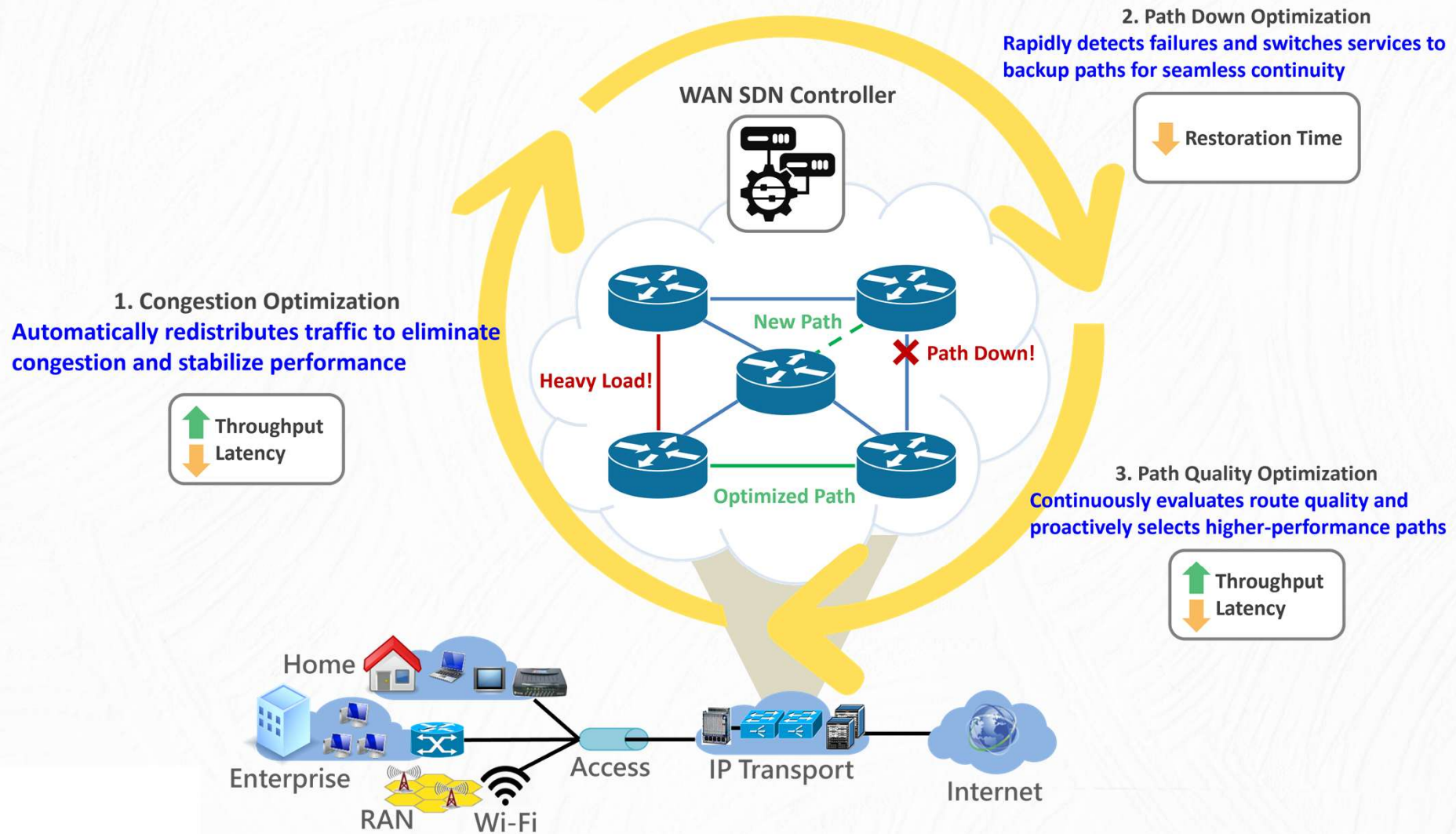
- Our IP Transport network serves as the backbone for **various types of services**, including:
  - Home Broadband (FTTx): provides high-speed residential connectivity
  - Enterprise Private Lines (E-LINE, E-LAN, ...): ensures secure and reliable business communications
  - Mobile Backhaul (4G, 5G): supports massive mobile data traffic with low latency and high resilience
  - Public Wireless LAN (PWLAN): delivers seamless wireless access in public spaces



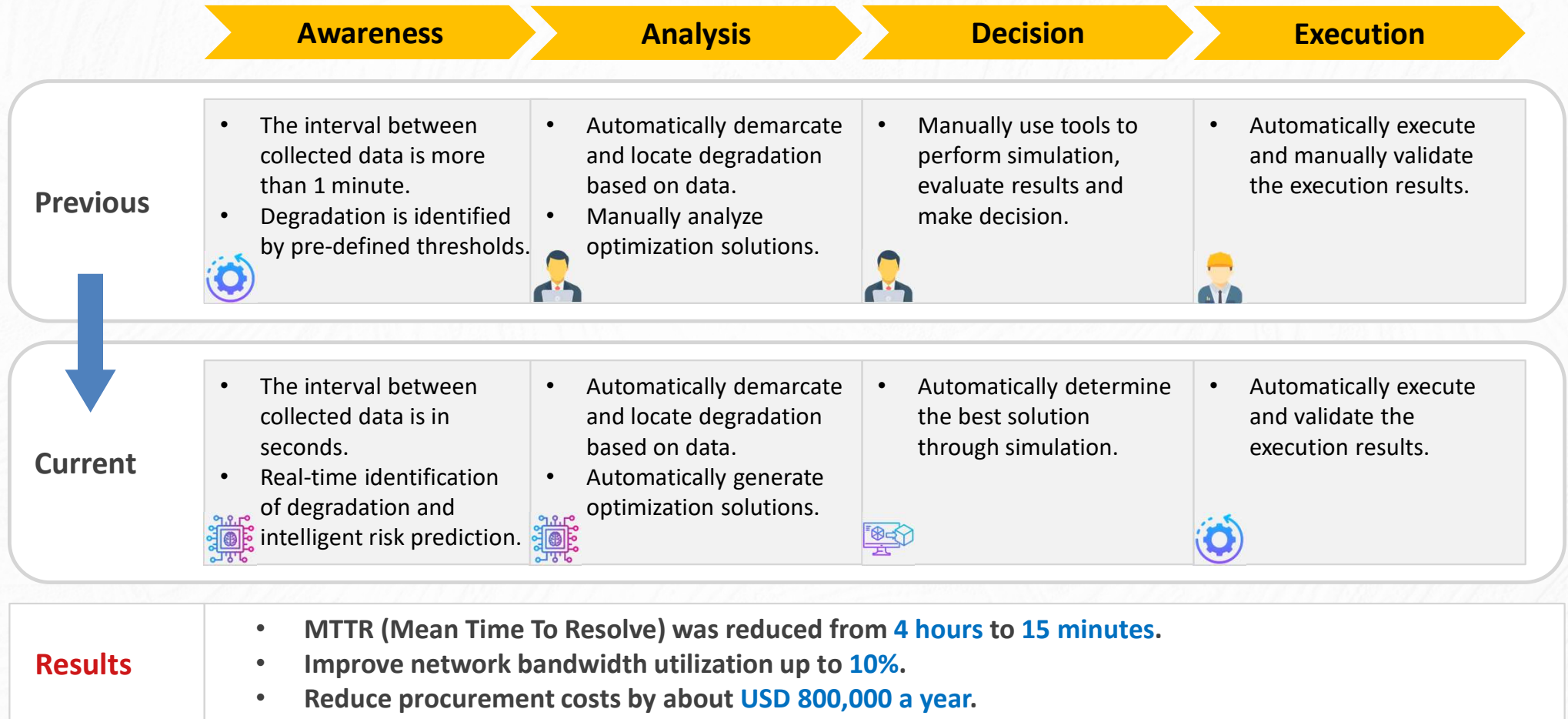
IP Transport is the **critical backbone** of our networks, providing the foundation for reliability, scalability, and high-quality connectivity.



# IP Network Quality Optimization Scenario

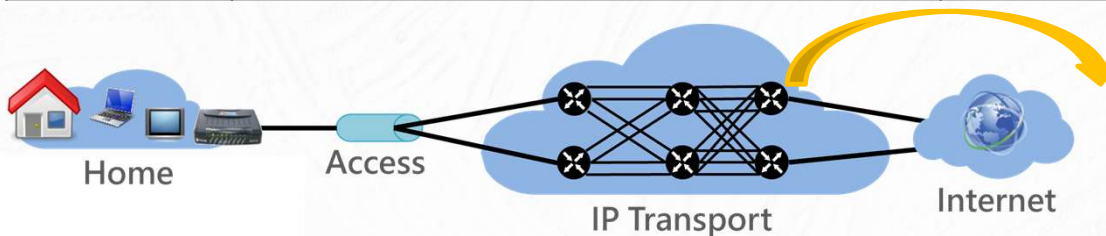


# Processes Transformation



# Evaluation Results

Cognitive Capability	Service Capability	Weight	Answer (Weighting is based on the CHT's situation)			Overall Score
			Congestion Optimization	Path Down Optimization	Path Quality Optimization	
			45%	10%	45%	
Intent	Quality optimization intent formulation	10%	A	A	A	3.7
Awareness	Identification of network KPI degradation	15%	A	A	A	
	Identification of service (e.g., mobile backhaul, private line) degradation	15%	B	B	B	
Analysis	Demarcation and locating	20%	A	A	A	
	Solution generation	20%	A	A	A	
Decision	Solution decision-making	10%	A	A	A	
Execution	Solution execution and verification	10%	A	A	A	



Since IP network links are designed with redundancy, the likelihood of a complete path failure is very low. This means that congestion and path quality degradation occur much more frequently. That is why we assign higher weights to congestion optimization and path quality optimization compared to path down optimization.



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# Evidences

Quality optimization intent formulation

Identification of network KPI degradation

Identification of service degradation

Demarcation and locating

Solution generation

Solution decision-making

Solution execution and verification

Question	Option A	Option B	Option C	Option D
Does the system support the input of quality optimization intents?	The system supports the input of quality optimization intent by simplified human-system interaction (e.g., nature language user interface provided by system), system automatically translates the intent into optimization policies.	The system supports manual configuration of optimization policies with customized rule-based templates (support combination of different optimization policies).	The system has built-in optimization predefined rules (support only one optimization policy) and converts to the optimization policies.	Manually configure optimization policies by tools.

**Evidence for congestion optimization and path quality optimization:** The system provides a **simplified human-machine interface**, allowing users to express optimization requirements in natural language. It automatically translates these intents into optimization policies that meet SLA requirements such as bandwidth, latency, and packet loss.

請將已部署在高雄<->台北、高雄<->台中、台中<->台北的ELINE電路，將SLA調整為保證電路頻寬為2Gbps與延遲低於20ms，並且具備前7天的電路擁塞預測與疏通功能嗎？

以下是高雄<->台北、高雄<->台中、台中<->台北的ELINE電路，共10筆，確認需要把將SLA調整為保證電路頻寬為2Gbps與延遲低於20ms，並且具備前7天的電路擁塞預測與疏通功能嗎？

#	線路名稱	業務類型	終端名稱	終端保證	Color	保證	高保	管理狀態		
1	---	ELINE		for RAMS to request SPACE create exclusive-sdp	230000035	100	52	100	UP	
2	---	ELINE		for RAMS to request SPACE create exclusive-sdp	230000035	100	90	100	52	UP
3	---	ELINE		for RAMS to request SPACE create exclusive-sdp	230000034	100	117	100	52	UP
4	---	ELINE		for RAMS to request SPACE create exclusive-sdp	230000034	100	52	100	117	UP
5	---	ELINE		for RAMS to request SPACE create exclusive-sdp	230000033	100	90	100	50	UP
6	---	ELINE		for RAMS to request SPACE create exclusive-sdp	230000033	100	20	100	90	UP
7	---	ELINE		for RAMS to request SPACE create exclusive-sdp	230000032	100	52	100	90	UP
8	---	ELINE		for RAMS to request SPACE create exclusive-sdp	230000032	100	90	100	52	UP
9	---	ELINE		for RAMS to request SPACE create exclusive-sdp	230000031	100	117	100	52	UP
10	---	ELINE		for RAMS to request SPACE create exclusive-sdp	230000031	100	52	100	117	UP

The system lists the affected paths

項目	參數
SLA-1 項目：保證頻寬	2 Gbps
SLA-2 項目：保證延遲	20 ms
SLA-3 項目：預測頻寬擁塞	前 7 天
路徑擁塞智慧疏通開關狀態	開啟
路徑斷線檢測開關	關閉

With the SLA requirements and capabilities presented in a table for the user to confirm. Note that the path down optimization is **not enabled**.

是的，請幫忙執行調整

User requests the system to perform an optimization of the existing paths to meet a bandwidth of 2 Gbps, latency below 20 ms, and to enable link traffic prediction for the next 7 days along with congestion mitigation.

The system can optionally integrate AI-predicted future values to ensure that future SLA requirements will continue to be met.

Identical to this SLA requirement

User confirms the execution

> Path computation and deploy

Please type or click source device and destination device on topology graph

Source Device\*  
100.100.100.52

Destination Device\*  
100.100.100.90

Objective

Bandwidth

Latency Measurement

Bandwidth(AI)

Latency Measurement(AI)

Bandwidth (Mbps)  
2000

latency (ms)  
20

time  
7

prediction for the next 7 days

PATH COMPUTATION CANCEL

已完成高雄<->台北、高雄<->台中、台中<->台北的ELINE電路，共10筆的SLA調整

Quality optimization intent formulation

Identification of network KPI degradation

Identification of service degradation

Demarcation and locating

Solution generation

Solution decision-making

Solution execution and verification

Question	Option A	Option B	Option C	Option D
Does the system support the input of quality optimization intents?	The system supports the input of quality optimization intent by simplified human-system interaction (e.g., nature language user interface provided by system), system automatically translates the intent into optimization policies.	The system supports manual configuration of optimization policies with customized rule-based templates (support combination of different optimization policies).	The system has built-in optimization predefined rules (support only one optimization policy) and converts to the optimization policies.	Manually configure optimization policies by tools.

**Evidence for path down optimization:** In this case, we enable the path down optimization feature, and it automatically translates these intents into optimization policies.

請將已部署在高雄<->台北、高雄<->台中、台中<->台北的ELINE電路，將SLA調整為保證電路頻寬為1Gbps與延遲低於100ms，並且開啟路徑斷線檢測機制與疏通功能嗎？

以下是高雄<->台北、高雄<->台中、台中<->台北的ELINE電路，共10筆，確認需要把將SLA調整為保證電路頻寬為1Gbps與延遲低於100ms，並且開啟路徑斷線檢測機制與疏通功能嗎？

#	電路名稱	服務類型	政策名稱	政策描述	Color	保證	延遲	管理狀態
1	---	ELINE		for FRMS to request SPACE create exclusive-sdp	23000033	100	52	100 UP
2	---	ELINE		for FRMS to request SPACE create exclusive-sdp	23000035	100	36	100 52 UP
3	---	ELINE		for FRMS to request SPACE create exclusive-sdp	23000034	100	17	100 52 UP
4	---	ELINE		for FRMS to request SPACE create exclusive-sdp	23000034	100	52	100 17 UP
5	---	ELINE		for FRMS to request SPACE create exclusive-sdp	23000033	100	30	100 20 UP
6	---	ELINE		for FRMS to request SPACE create exclusive-sdp	23000033	100	20	100 30 UP
7	---	ELINE		for FRMS to request SPACE create exclusive-sdp	23000032	100	52	100 30 UP
8	---	ELINE		for FRMS to request SPACE create exclusive-sdp	23000032	100	30	100 52 UP
9	---	ELINE		for FRMS to request SPACE create exclusive-sdp	23000031	100	17	100 52 UP
10	---	ELINE		for FRMS to request SPACE create exclusive-sdp	23000031	100	52	100 17 UP

The system lists the affected paths

項目	參數
SLA-1 項目：保證頻寬	1 Gbps
SLA-2 項目：保證延遲	100 ms
路徑斷線警報疏通開關狀態	開啟
路徑斷線檢測開關	開啟

With the SLA requirements and capabilities presented in a table for the user to confirm. Note that the path down optimization is enabled.

是的，請幫忙執行調整

Identical to this SLA requirement

User confirms the execution

已完成高雄<->台北、高雄<->台中、台中<->台北的ELINE電路，共10筆的SLA調整

> Path computation and deploy

Please type or click source device and destination device on topology graph

Source Device\*  
100. [redacted] 52

Destination Device\*  
100. [redacted] 17

Objective

Bandwidth

Latency Measurement

Bandwidth(AI)

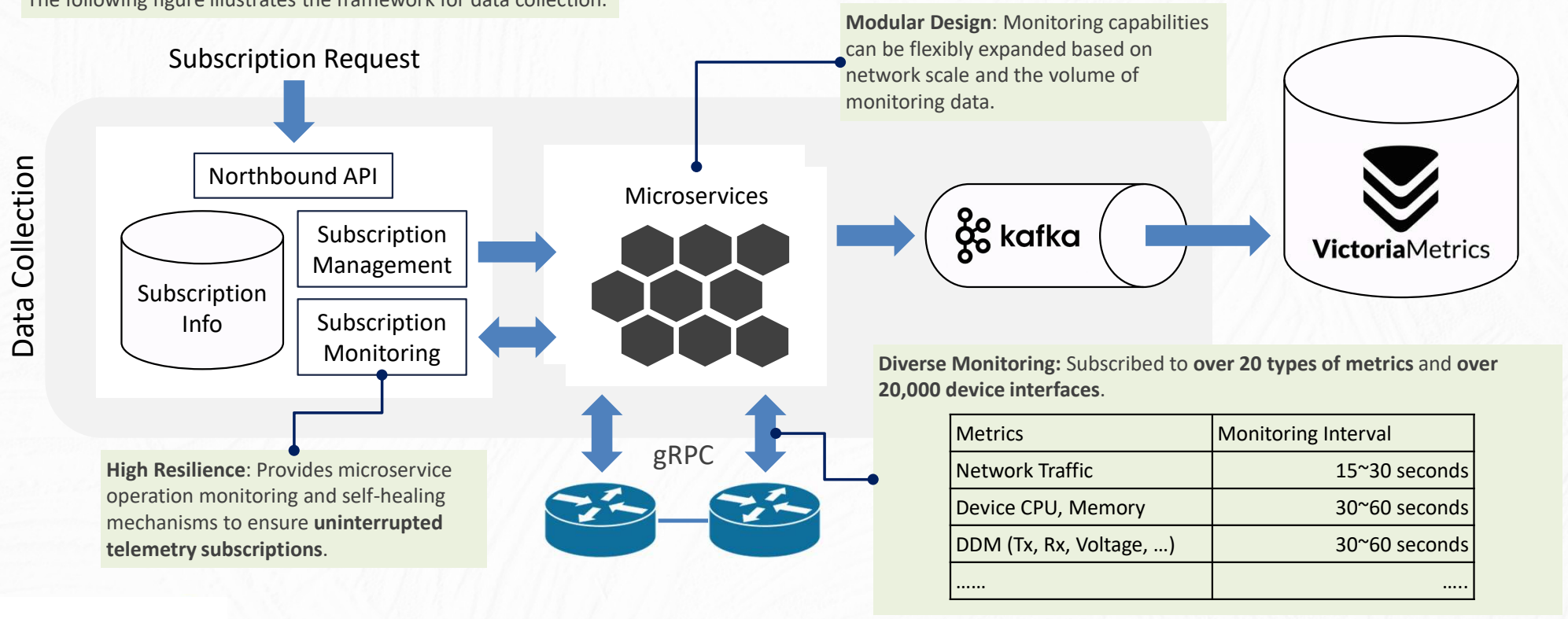
Latency Measurement(AI)

Bandwidth (Mbps)  
1000

latency (ms)  
100

Question	Option A	Option B	Option C	Option D
Does the system support real-time collection of network KPI and identification of KPI degradation?	The system supports collect and display network KPI in seconds, supporting real-time identification of network degradation and intelligent risk prediction based on historical data.	The system supports collect and display network KPI in seconds, supporting real-time identification of network degradation.	The system supports collect and display network KPI in more than 1 minute (e.g., 15 minutes) . System identify KPI degradation by pre-defined threshold.	The system collects network quality information and manually identify KPI degradation.

The following figure illustrates the framework for data collection.



Quality optimization intent formulation

Identification of network KPI degradation

Identification of service degradation

Demarcation and locating

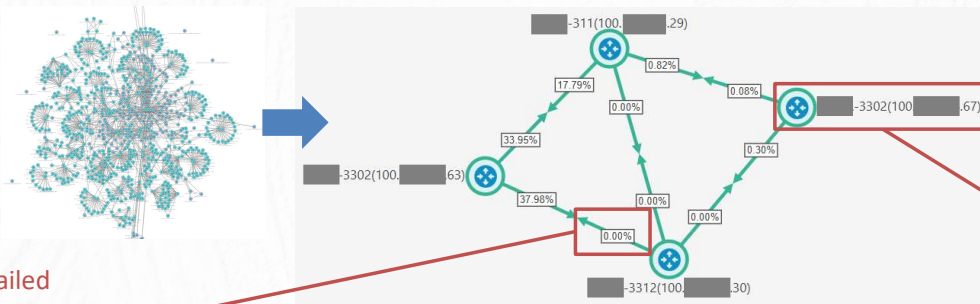
Solution generation

Solution decision-making

Solution execution and verification

Question	Option A	Option B	Option C	Option D
Does the system support real-time collection of network KPI and identification of KPI degradation?	The system supports collect and display network KPI in seconds, supporting real-time identification of network degradation and intelligent risk prediction based on historical data.	The system supports collect and display network KPI in seconds, supporting real-time identification of network degradation.	The system supports collect and display network KPI in more than 1 minute (e.g., 15 minutes) . System identify KPI degradation by pre-defined threshold.	The system collects network quality information and manually identify KPI degradation.

The WAN SDN Controller offers both global topology for visualization and personal topology for detailed information about nodes and links.



Click the links will show the detailed information related to the link

Click the nodes will show the detailed information related to the device

Source Node: -3312  
 Hostname: -3312  
 Target Node: -3302  
 Hostname: -3302  
 Source Interface IP: 100.0.0.30  
 Target Device IP: 100.0.0.67  
 Level Type: Level 1

**Advanced Properties**

Column	Value
Link Status	UP
Source Interface IP	172.17.0.140
Target Interface IP	172.17.0.141
Adj SID	---
Backup Adj SID	515730
IGP Metric	100
Logical Port	lag-5
Physical Ports	5/1/2, 5/2/6
Available Bandwidth(kbps)	11815571.03
Used Bandwidth(kbps)	8184428.97
Used Bandwidth Ratio(%)	40.95
Latency(ms)	0.24

Router ID: 100.0.0.67  
 Hostname: 302  
 Room: 6E6  
 Branch: 6E6  
 Device Vendor: NOKIA  
 Device Level: ND  
 Protocol: ISIS  
 Node Status: UP  
 Manage Status: MANAGED  
 Level Type: Level 1  
 Area ID: 49.0006  
 System ID: 1001.2725.4067  
 Node SID: 320317  
 Anycast SID: Unset  
 AS: 65003  
 Domain: 2

**Advanced Properties**

Prefix	Metric
100.0.0.67/32	---
172.17.0.140/32	---
172.17.0.141/32	---

Rows per page: 10

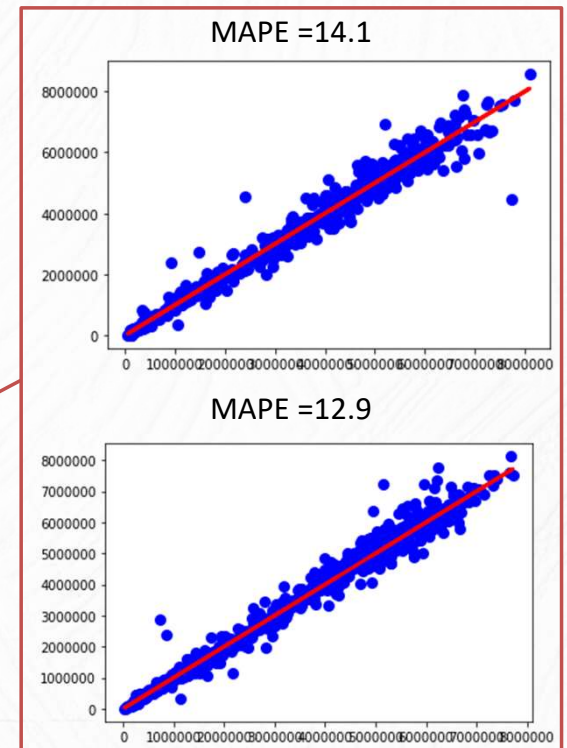
Detailed KPIs (shown in next page)

Question	Option A	Option B	Option C	Option D
Does the system support real-time collection of network KPI and identification of KPI degradation?	The system supports collect and display network KPI in seconds, supporting real-time identification of network degradation and intelligent risk prediction based on historical data.	The system supports collect and display network KPI in seconds, supporting real-time identification of network degradation.	The system supports collect and display network KPI in more than 1 minute (e.g., 15 minutes) . System identify KPI degradation by pre-defined threshold.	The system collects network quality information and manually identify KPI degradation.

Beyond monitoring current network performance, the system **forecasts future trends** to support risk prediction. The system uses historical data and AI algorithms to predict traffic patterns, **enabling proactive optimization decisions**. This predictive capability enhances network resilience by anticipating congestion or degradation before they occur.



The actual prediction accuracy: MAPE (Mean Absolute Percentage Error) is under 20



Quality optimization  
intent formulation

Identification of network  
KPI degradation

Identification of  
service degradation

Demarcation  
and locating

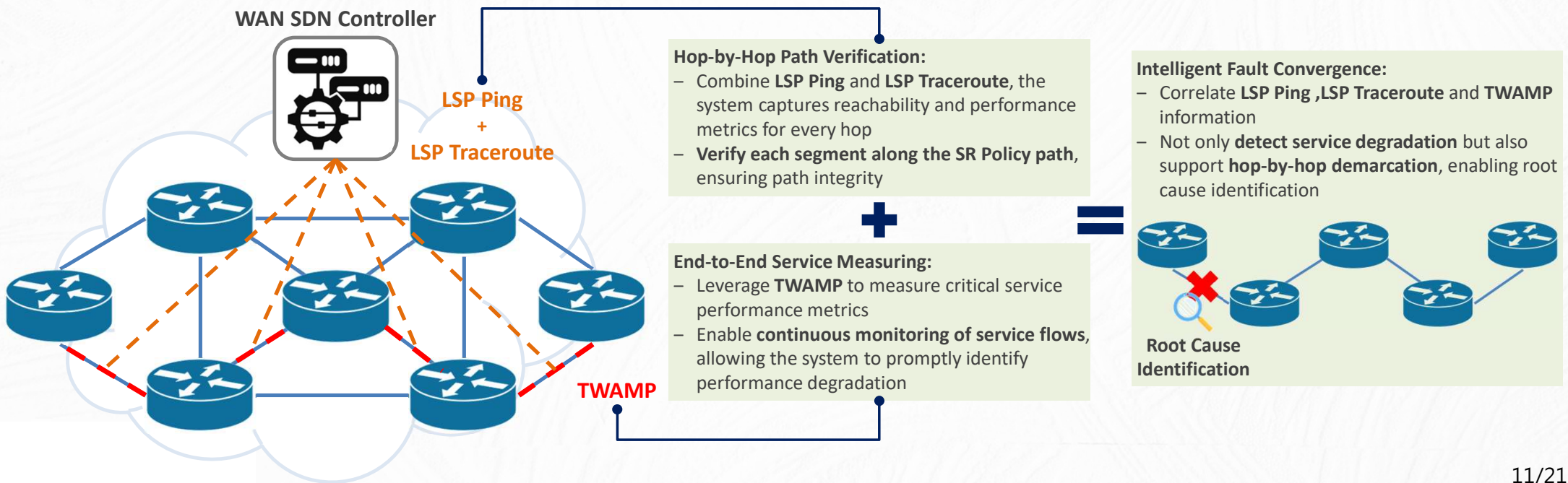
Solution  
generation

Solution  
decision-making

Solution execution  
and verification

Question	Option A	Option B	Option C	Option D
Does the system support automatic identification of service and service flow degradation?	The system supports automatic path-congruent OAM mechanism (e.g., ifit, iOAM) to identify service degradation, supporting hop-by-hop demarcation, listing the impacted services. The system supports identification of degradation of different service flows (e.g., game, short video).	The system supports automatic non-path-congruent OAM mechanism (e.g., TWAMP, Y.1731) to identify service degradation.	Manually analyze service degradation based on system-collected performance data, logs, etc.	Not an option.

The system leverages a composite mechanism that integrates routing, reachability, and performance data. By correlating these dimensions, it not only detects service degradation in real time but also performs hop-by-hop demarcation across the IP network.



Quality optimization  
intent formulation

Identification of network  
KPI degradation

Identification of  
service degradation

Demarcation  
and locating

Solution  
generation

Solution  
decision-making

Solution execution  
and verification

Question	Option A	Option B	Option C	Option D
Does the system support automatic identification of service and service flow degradation?	The system supports automatic path-congruent OAM mechanism (e.g., ifit, iOAM) to identify service degradation, supporting hop-by-hop demarcation, listing the impacted services. The system supports identification of degradation of different service flows (e.g., game, short video).	The system supports automatic non-path-congruent OAM mechanism (e.g., TWAMP, Y.1731) to identify service degradation.	Manually analyze service degradation based on system-collected performance data, logs, etc.	Not an option.

The system leverages TWAMP to collect service-related KPIs, enabling end-to-end performance monitoring and ensuring visibility into service health. The collected data is displayed on the Path Info page, where users can easily review performance indicators. By correlating TWAMP and traceroute information, the system supports **hop-by-hop demarcation for service degradation**.



Question	Option A	Option B	Option C	Option D
Does the system support automatic and intelligent demarcation and locating of service degradation, supporting automatic and intelligent analysis of the cause?	1) The system automatically and intelligently demarcates specific node(s) or link(s) that lead to the service degradation. 2) The system automatically and intelligently locate the root cause of network degradation (e.g., interface congestion).	1) The system automatically demarcates specific node(s) or link(s) that lead to the network degradation. 2) Automatically provides one or more suspected causes of network degradation, manually confirm.	Manually demarcates and locates network degradation based on suggestions and network data provided by system.	Manually demarcates and locates network degradation by CLI.

1) The system **monitors SLA deviations by comparing real-time data with AI/ML-predicted baselines**. When deviations are detected, advanced analysis identifies root causes such as congestion, path down, or quality degradation, and triggers automated optimization. This page provides evidence demonstrating that the system **automatically triggers model retraining**, thereby ensuring that SLA deviation analysis continually maintains a reliable level of accuracy.

### Parameter Configurations

Settings related to model retraining

### Automatic Retraining

Exceeded the threshold, so retraining is triggered

Model version and training history

### Prediction Performance Visualization

Threshold exceeded

Retraining results in improved accuracy

- Real Value
- Predicted Value (with Retraining)
- Predicted Value (without Retraining)

Quality optimization intent formulation

Identification of network KPI degradation

Identification of service degradation

Demarcation and locating

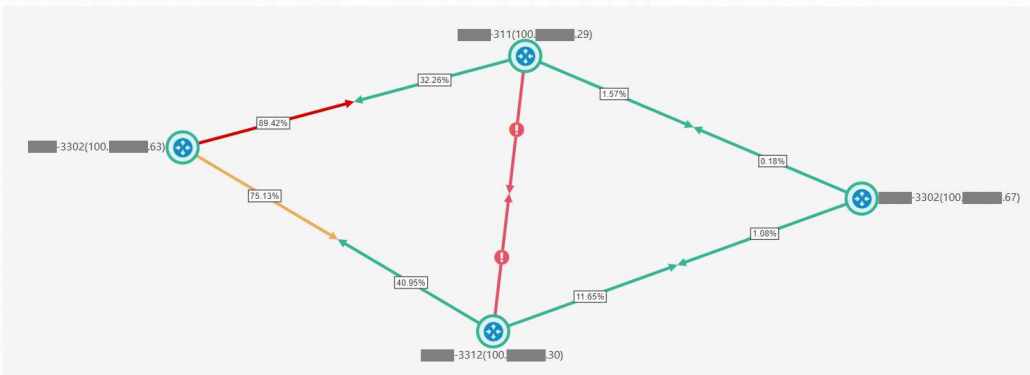
Solution generation

Solution decision-making

Solution execution and verification

Question	Option A	Option B	Option C	Option D
Does the system support automatic and intelligent demarcation and locating of service degradation, supporting automatic and intelligent analysis of the cause?	<ol style="list-style-type: none"> <li>1) The system automatically and intelligently demarcates specific node(s) or link(s) that lead to the service degradation.</li> <li>2) The system automatically and intelligently locate the root cause of network degradation (e.g., interface congestion).</li> </ol>	<ol style="list-style-type: none"> <li>1) The system automatically demarcates specific node(s) or link(s) that lead to the network degradation.</li> <li>2) Automatically provides one or more suspected causes of network degradation, manually confirm.</li> </ol>	Manually demarcates and locates network degradation based on suggestions and network data provided by system.	Manually demarcates and locates network degradation by CLI.

2) The topology page uses color-coded status for nodes and links, **enabling quick pinpointing of degradation sources**. And for each path, the system automatically deploys the optimization solution and **records the reason behind every optimization action** in optimization records dialog.



Node Color	Meaning
Red	Malfunctioned
Green	Normal
Orange	Under Maintenance

Link Color	Meaning
Red	SLA Degradation >= 80%
Orange	50% < SLA Degradation < 80%
Green	SLA Degradation < 50%
Red with exclamation mark	Link Down

#### OPTIMIZATION RECORDS

**Policy Name** [Redacted]  
**Policy Description** latency computation  
**Color** 230000022  
**Headend** 100. [Redacted].84  
**Endpoint** 100. [Redacted].52  
**Policy Administrator** UP

#	Optimization Reason	Optimization Status
1	Latency	success
2	Link down	success
3	Node Fail	success
4	Congestion	success

The optimization records of each path will show the reason behind each optimization

Quality optimization intent formulation

Identification of network KPI degradation

Identification of service degradation

Demarcation and locating

**Solution generation**

Solution decision-making

Solution execution and verification

Question	Option A	Option B	Option C	Option D
Does the system automatically generate optimization solutions for network and service degradation?	<ol style="list-style-type: none"><li>1) The system automatically computes routes and generates optimization solutions that meet more than 2 kinds of SLA requirements (e.g., bandwidth &amp; delay &amp; packet loss).</li><li>2) The system automatically generates further precise capacity expansion suggestions and reasons (e.g., link between node A and node B needs capacity expansion).</li></ol>	The system automatically computes routes and generates optimization solutions that meet 1 specific SLA requirement (e.g., bandwidth or delay or packet loss).	The system generates optimization solution based on pre-defined rules, such as tunnel rerouting and VPN FRR(Fast reroute).	Manually analyze optimization solution based on expertise.

1) **Evidence for all sub-scenarios:** This page provides real system screenshots as supporting evidence for the capabilities described on the previous slide. The path computation supports fulfilling two or more SLA requirements simultaneously.

The system can dynamically enable the input fields based on the selected SLA types

The system can also optionally incorporate AI-predicted future values as part of the SLA constraints, ensuring that the anticipated conditions are taken into account so that future SLA requirements will continue to be met.

> Path computation and deploy

Please type or click source device and destination device on topology graph

Source Device\*  
100.1.1.56

Destination Device\*  
100.1.1.42

Objective

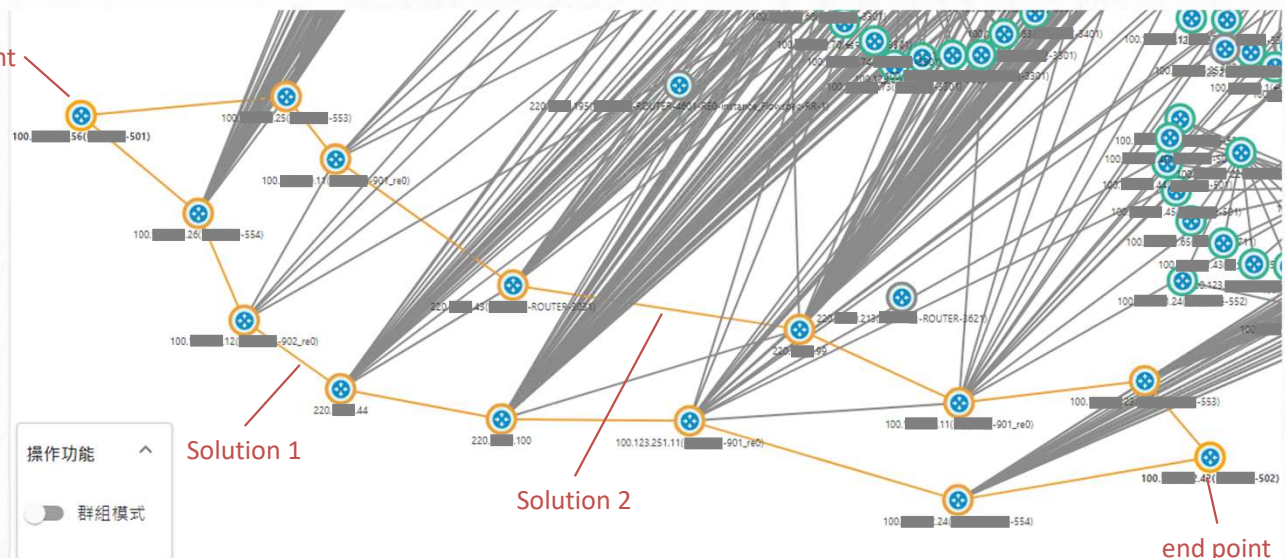
- Bandwidth
- Latency Measurement
- Bandwidth(AI)
- Latency Measurement(AI)

Bandwidth (Mbps)  
1000

latency (ms)  
100

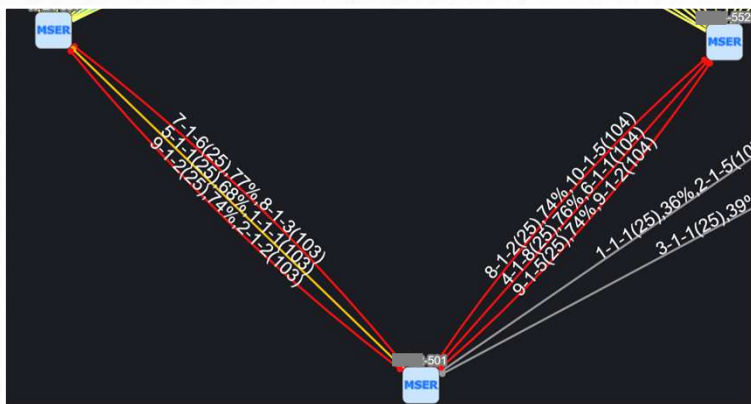
PATH COMPUTATION CANCEL

start point

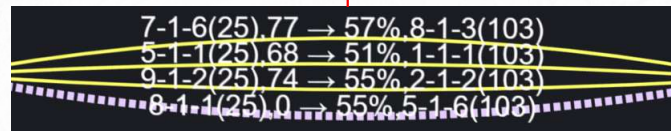


Question	Option A	Option B	Option C	Option D
Does the system automatically generate optimization solutions for network and service degradation?	<ol style="list-style-type: none"> <li>The system automatically computes routes and generates optimization solutions that meet more than 2 kinds of SLA requirements (e.g., bandwidth &amp; delay &amp; packet loss).</li> <li>The system automatically generates further precise capacity expansion suggestions and reasons (e.g., link between node A and node B needs capacity expansion).</li> </ol>	The system automatically computes routes and generates optimization solutions that meet 1 specific SLA requirement (e.g., bandwidth or delay or packet loss).	The system generates optimization solution based on pre-defined rules, such as tunnel rerouting and VPN FRR(Fast reroute).	Manually analyze optimization solution based on expertise.

2) A capacity expansion suggestion is shown in the figures below. This demonstrates the system's ability to go beyond rerouting and proactively recommend infrastructure improvements.



Links have reached the heavy-load threshold (marked in red), making rerouting infeasible for this congestion optimization.



The generated capacity expansion suggestion

The yellow lines represent the existing links, while the purple dashed line indicates the proposed capacity expansion

Quality optimization intent formulation

Identification of network KPI degradation

Identification of service degradation

Demarcation and locating

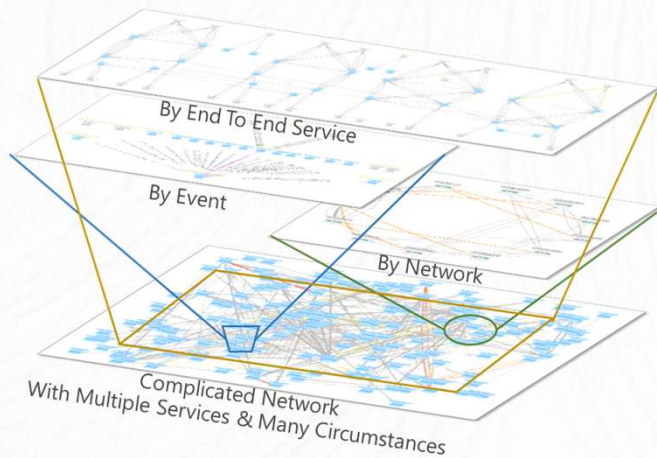
Solution generation

Solution decision-making

Solution execution and verification

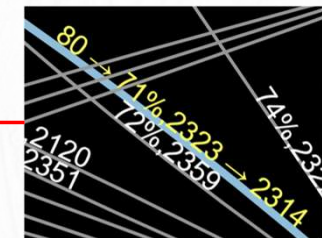
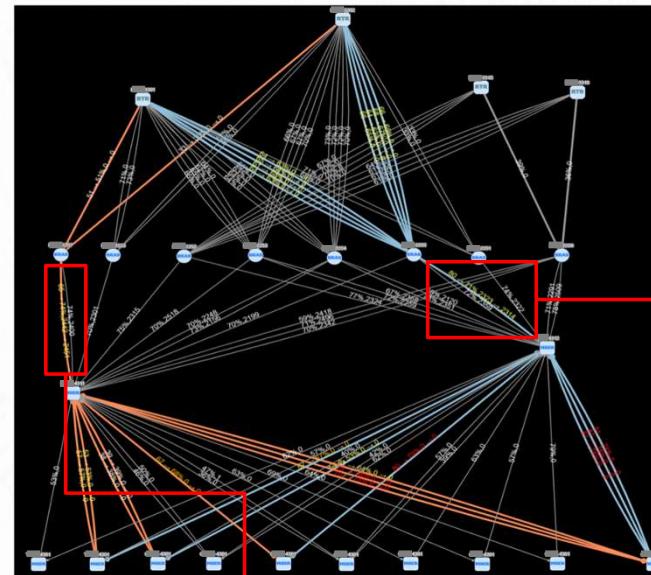
Question	Option A	Option B	Option C	Option D
Does the system support automatic decision-making on path optimization solutions?	Through evaluating simulation results, the system automatically determines the solution that meets the SLA requirements.	The system automatically determines the solution that meet the SLA requirements based on pre-defined rules. Manually make decision.	Manually use tools to perform simulation, evaluate results and make decision.	Manually evaluate the optimization solution based on expertise and make decision.

The system uses digital twin simulation to assess optimization impacts at different levels, as illustrated in the figures below.

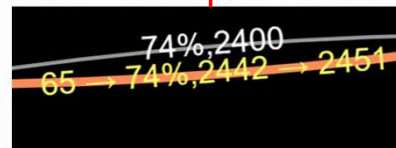


The digital twin simulation can be performed at different levels: by service, by event, or by network domain

Simulation for an optimization action



Simulation shows that bandwidth utilization will decrease from 80% to 71% after optimization



Simulation shows that bandwidth utilization will increase from 65% to 74% after optimization

Quality optimization intent formulation

Identification of network KPI degradation

Identification of service degradation

Demarcation and locating

Solution generation

Solution decision-making

Solution execution and verification

Question	Option A	Option B	Option C	Option D
Does the system support automatic decision-making on path optimization solutions?	Through evaluating simulation results, the system automatically determines the solution that meets the SLA requirements.	The system automatically determines the solution that meet the SLA requirements based on pre-defined rules. Manually make decision.	Manually use tools to perform simulation, evaluate results and make decision.	Manually evaluate the optimization solution based on expertise and make decision.

The system is designed to **automatically deploy the optimization solution** for each path when degradation is detected. It also records detailed path information for every optimization action, ensuring transparency and traceability. The final optimization decision is based on the path ranking calculated in solution generation, which was then validated through Digital Twin simulation.

OPTIMIZATION RECORDS

Policy Name: [Redacted]  
 Policy Description: latency computation  
 Color: 230000022  
 Headend: 100. [Redacted]. 84  
 Endpoint: 100. [Redacted]. 52  
 Policy Administrator: UP

#	Optimization Reason	Optimization Status	StartTime	End Time	Paths
1	Latency	success	2025-10-12 02:26:00	2025-10-12 02:27:00	[Icon]
2	Link down	success	2025-10-09 10:25:00	2025-10-09 10:26:00	[Icon]

Each optimization action is accompanied by a detailed paths record

#	Candidate Path name	Candidate Description	Protocol	Distinguisher	BSID	Candidate Administration
1	candidate path AZ	AZ	BGP	101027	60010	UP

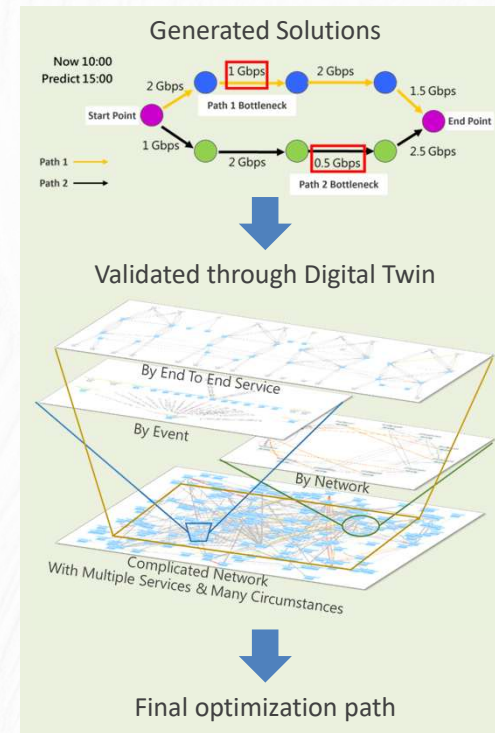
  

SID	Hostname	Router ID	Level	Hop
301527	-553	100. [Redacted]. 27	N1	
301511	-901_re0	100. [Redacted]. 11	ICSR	1
350287	-ROUTER-3031	220. [Redacted]. 3	CR	
350187	-ROUTER-3031	220. [Redacted]. 3	CR	
300011	901_re0	100. [Redacted]. 11	ICSR	2
300021	553	100. [Redacted]. 21	N1	
300052	501	100. [Redacted]. 52	NO	3

SID	Hostname	Router ID	Level	Hop
301528	-554	100. [Redacted]. 28	N1	
301512	-902_re0	100. [Redacted]. 12	ICSR	1
350288	-ROUTER-3032	220. [Redacted]. 3	CR	
350186	-ROUTER-3052	220. [Redacted]. 2	CR	
350188	-ROUTER-3032	220. [Redacted]. 3	CR	
301011	-901_re0	100. [Redacted]. 11	ICSR	
300022	-554	100. [Redacted]. 22	N1	
300052	-501	100. [Redacted]. 52	NO	2

The optimization path is the chosen solution



Quality optimization intent formulation

Identification of network KPI degradation

Identification of service degradation

Demarcation and locating

Solution generation

Solution decision-making

Solution execution and verification

Question	Option A	Option B	Option C	Option D
Does the system support automatic execution and visualized verification (e.g., supporting automatic replay of optimization records during a time period) of path optimization?	The system supports automatic execution and verification of the optimization solution, which supports visualized replay capabilities of optimization records.	The system supports automatic execution and verification of optimization solutions. But does not support visualized replay capabilities of optimization records.	Perform the optimization and verification manually.	Not an option.

**Evidence for path down optimization:** The optimization records include the execution and verification status of each optimization action. Meanwhile users can then **replay and inspect the optimization history** with before/after topology views.

OPTIMIZATION RECORDS ✕

**Policy Name** [redacted]  
**Policy Description** latency computation  
**Color** 230000022  
**Headend** 100.[redacted].84  
**Endpoint** 100.[redacted].52  
**Policy Administrator** UP

Execution and verification status

#	Optimization Reason	Optimization Status	StartTime	End Time	Paths
1	Latency	success	2025-10-12 02:26:00	2025-10-12 02:27:00	📄
2	Link down	success	2025-10-09 10:25:00	2025-10-09 10:26:00	📄

The paths detail further visualizes the before and after topologies by clicking the icon

#	Candidate Path name	Candidate Description	Protocol	Distinguisher	BSID	Candidate Administration
1	candidate path AZ	AZ	BGP	101027	60010	UP

ORIGINAL PATHS 👁 Before

OPTIMIZATION PATHS 👁 After

Root Cause (Link Down)

Quality optimization intent formulation

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Question	Option A	Option B	Option C	Option D
Does the system support automatic execution and visualized verification (e.g., supporting automatic replay of optimization records during a time period) of path optimization?	The system supports automatic execution and verification of the optimization solution, which supports visualized replay capabilities of optimization records.	The system supports automatic execution and verification of optimization solutions. But does not support visualized replay capabilities of optimization records.	Perform the optimization and verification manually.	Not an option.

**Evidence for congestion optimization and path quality optimization:** The Evidences of these 2 sub-scenarios are shown in the following figures. Since the topology view visualizes SLA degradation using the same color indicators (e.g., red/yellow links), the evidence for congestion optimization and path quality optimization appears identical. Therefore, the topology view shows **no visual distinction between them before or after the optimization**.

OPTIMIZATION RECORDS

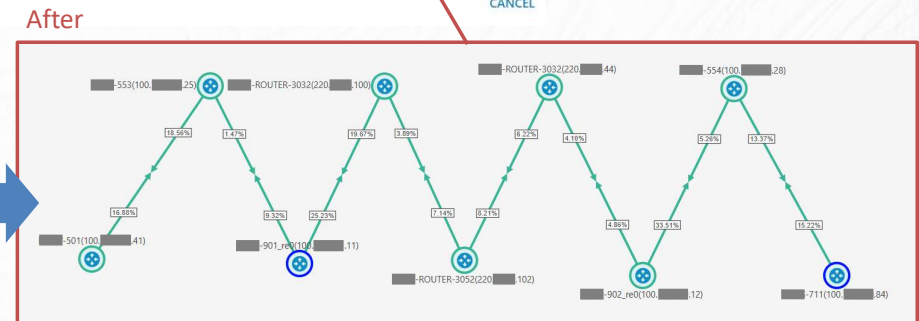
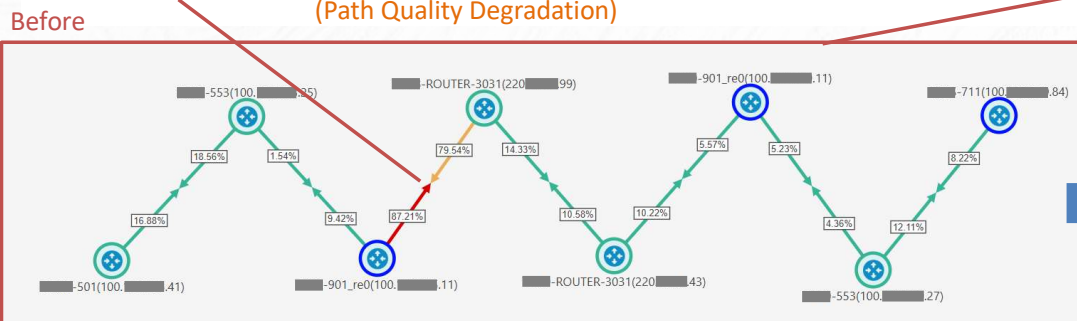
Policy Name  
 Policy Description latency computation  
 Color 230000016  
 Headend 100. .41  
 Endpoint 100. .84  
 Policy Administrator UP

Execution and verification status

#	Optimization Reason	Optimization Status	StartTime	End Time	Paths
1	Congestion	success	2025-10-15 03:26:00	2025-10-15 03:27:00	
2	Latency	success	2025-10-12 02:26:00	2025-10-12 02:27:00	

Link Color	Meaning
Red	SLA Degradation >= 80%
Yellow	50% < SLA Degradation < 80%
Green	SLA Degradation < 50%
Red with exclamation mark	Link Down

Note: There is no distinction between congestion and path quality in the topology.



Quality optimization intent formulation

Identification of network KPI degradation

Identification of service degradation

Demarcation and locating

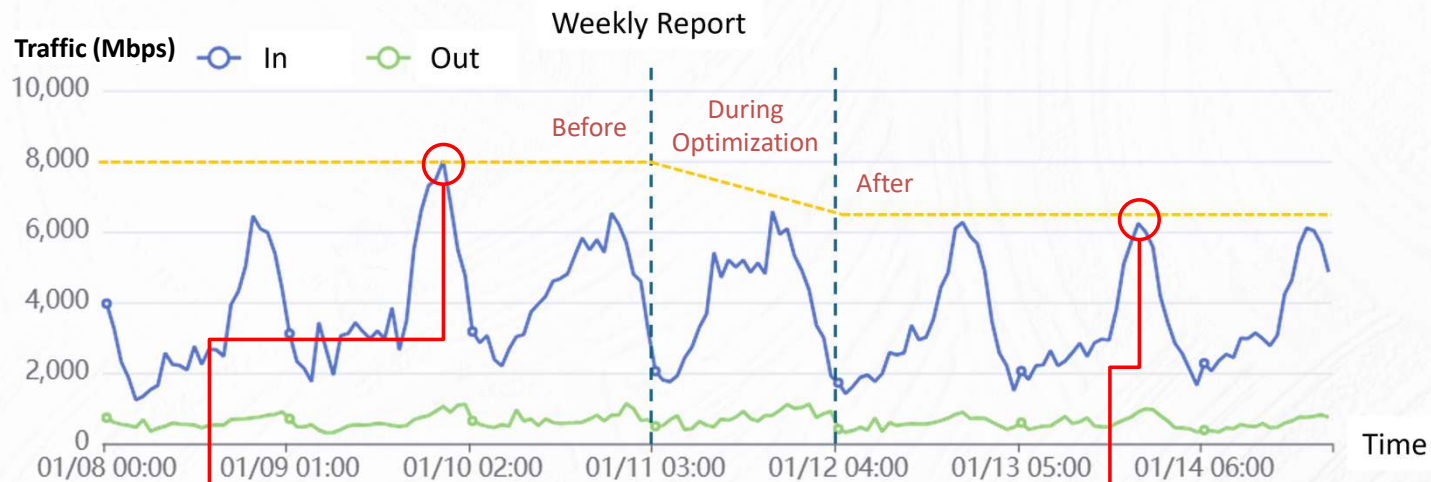
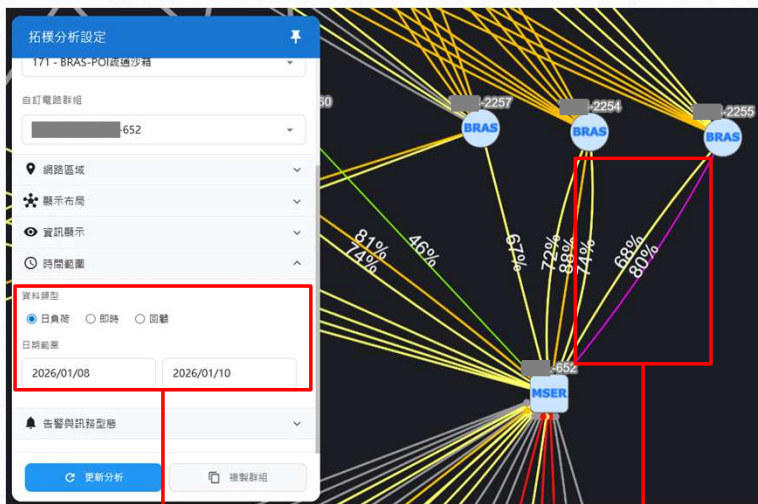
Solution generation

Solution decision-making

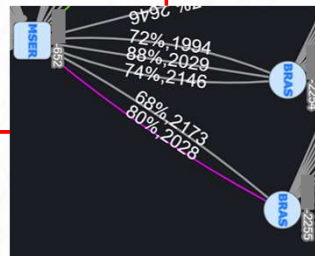
Solution execution and verification

Question	Option A	Option B	Option C	Option D
Does the system support automatic execution and visualized verification (e.g., supporting automatic replay of optimization records during a time period) of path optimization?	The system supports automatic execution and verification of the optimization solution, which supports visualized replay capabilities of optimization records.	The system supports automatic execution and verification of optimization solutions. But does not support visualized replay capabilities of optimization records.	Perform the optimization and verification manually.	Not an option.

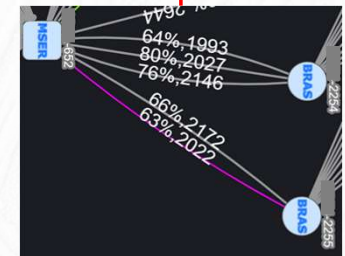
**Evidence for before and after performance:** This page provides the **performance differences before and after optimization**. The Digital Twin system also supports **replaying historical data**. After selecting a specific time, it can reproduce the topology, providing another visualized replay capability.



The system can reproduce the topology and the corresponding network conditions based on the selected date range



The system automatically executed 6 optimizations, reducing bandwidth utilization by 17% (from 80% to 63%) and effectively mitigating link congestion.





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T H A N K Y O U

