PoC #16: AI based family broadband network user experience optimization

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Acronyms

Acronyms	
CDN	Content Delivery Network
DPI	Deep Packet Inspection
EPG	electrical program guide
LGBM	light gradient boosting machine
NPS	Net Promoter Score
PON	Passive Optical Network
XDR	X Detail Record

PoC milestones

PoC Milestone	Stages/Milestone description	Target Date	Additional Info	Current status
P.S	PoC Project Start	09/2022		
P.D1	PoC Demo 1	12/2022	Demo at an ENI plenary meeting	
P.C1	PoC Expected Contribution 1	12/2022	Contribution to ENI Requirements	
P.C2	PoC Expected Contribution 2	03/2023	Contribution to ENI Use Cases	★
P.R	PoC Report	06/2023	PoC-Project-End Feedback	
P.E	PoC Project End	07/2023	Presented to ISG ENI for information	
Milestones need to be entered in chronological order. NOTE:				

Table of Contents

1. Review
2. Status update

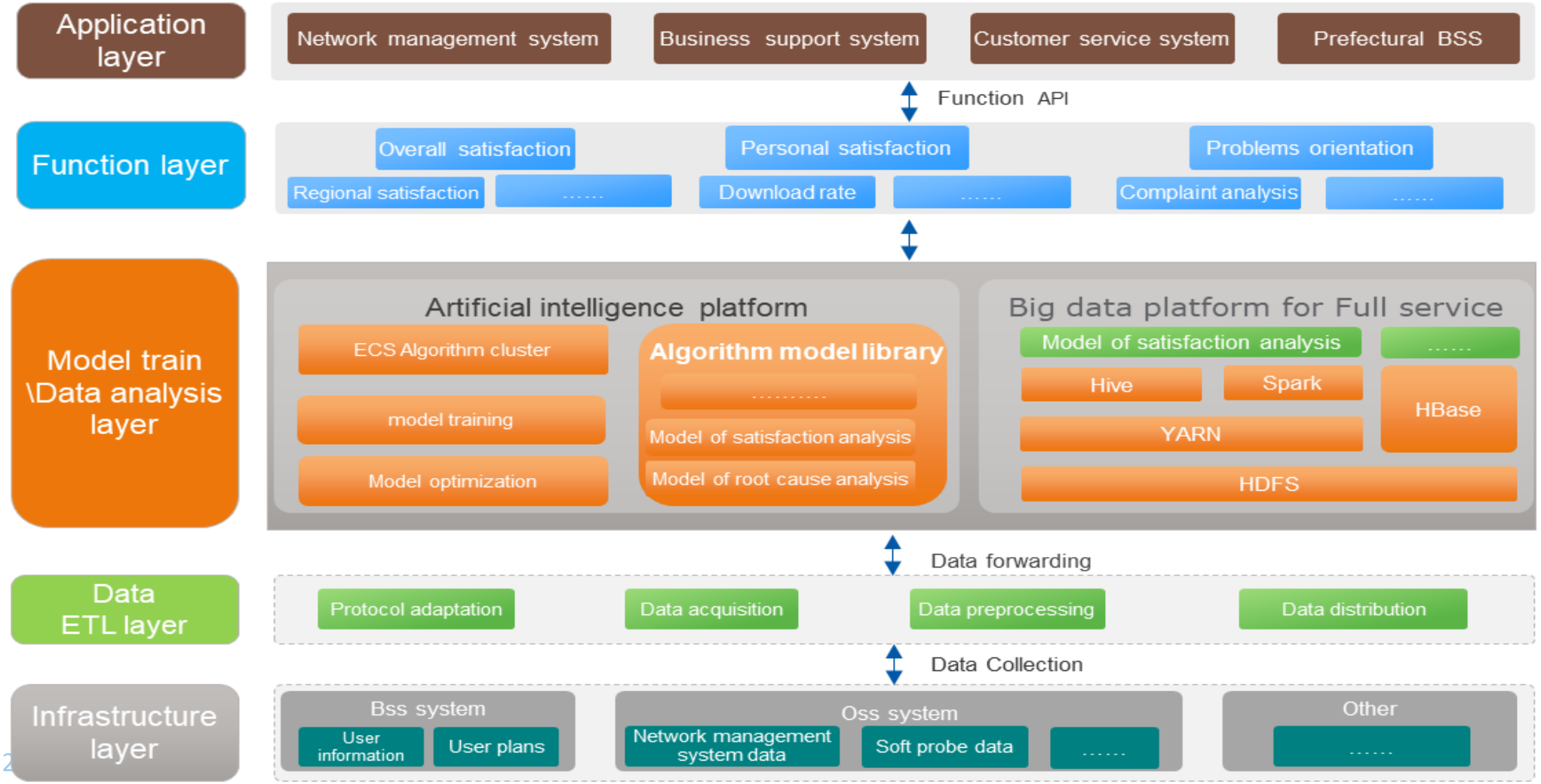
PoC goal

PoC Project Goal #1: Demonstrate user experience perception assessment system
Select KPI （Key Performance Indicators）affecting user experience to construct user experience perception assessment system, including user subjective assessment and system objective assessment.

PoC Project Goal #2: Demonstrate using big data, AI technology and expertise to train AI model of family broadband network user experience optimization, analyses user experience data, solve user experience problem and improve user experience perception.

PoC Architecture

PoC architecture includes five parts, showing the complete process of customer experience optimization.



PoC user story

UC #1 AI based family broadband network user experience optimization.

Preconditions: ENI system can get customer experience data by operator. The customer experience data used to model train should be typical, comprehensive and accurate.

NOTE： customer experience data include OSS data, BSS data, customer's subjective evaluation data and complaint data

Problem with conventional approach: during the services operation, operators often face the case that network performance of broadband network is good, but customers' experience is not as good as the network performance. It's hard to fully use the massive data from network by traditional methods for evaluating the user experience and resolving the related issues.

Objective: ENI system will get massive history data from operator, including OSS data, BSS data and customer's subjective evaluation and complaint data e.g., net promoter score data. These history data will be used to train customer experience model， and the qualified customer experience model will be stored in the ENI system. ENI system will get periodic operation data form operator, analyse and obtain poor quality users and the root causes of poor quality， and determine the poor quality optimization policy.

UC #1 AI based family broadband network user experience optimization

Operational flow of actions

Step 1: Training of intelligent model: ENI system periodically get history customer experience data to train intelligent customer experience optimization model.

NOTE: Massive history customer experience data: include OSS data, BSS data, customer's subjective evaluation data and complaint data.

Step 2: Triggering optimization: there are two triggering optimization situations. The first is ENI system obtaining periodic customer experience data from operator to analyse customer experience situation; the second is operator sending service optimization requests to ENI system.

Step 3: Policy generation: ENI system analyses customer experience data output optimization policy and sends optimization policy to operator.

NOTE: Policy may be used for network optimization, customer care, etc.

Step 4: Policy execution: operator receives optimization policy and pushes the optimization policy to the execution entity.

NOTE: according to the specific scenarios, the execution entity may be part of operation maintenance system of OSS or the business hall of BSS, etc.

Step 5: Policy enhancements: operator collects feature data from significantly improved in customer experience and sends feature data to ENI system for iterative optimization of intelligent customer experience optimization model.

NOTE： Feature data may be complaints, flow consumption, etc.

Step 6: The actual service scenario conditionally triggers full or part of above actions.

Design concept and functional architecture

The customer experience management system evaluates overall customer's service level, network quality and usage perception from the perspective of user experience, takes the user experience as the initiative to analyze the weaknesses in the business process, and then distributes them to the corresponding surrounding system for maintenance and support to achieve proactive customer care, solve the difference between the individual and the whole perception, improves the customer experience of family broadband network.

Design Concept

Experience Evaluation

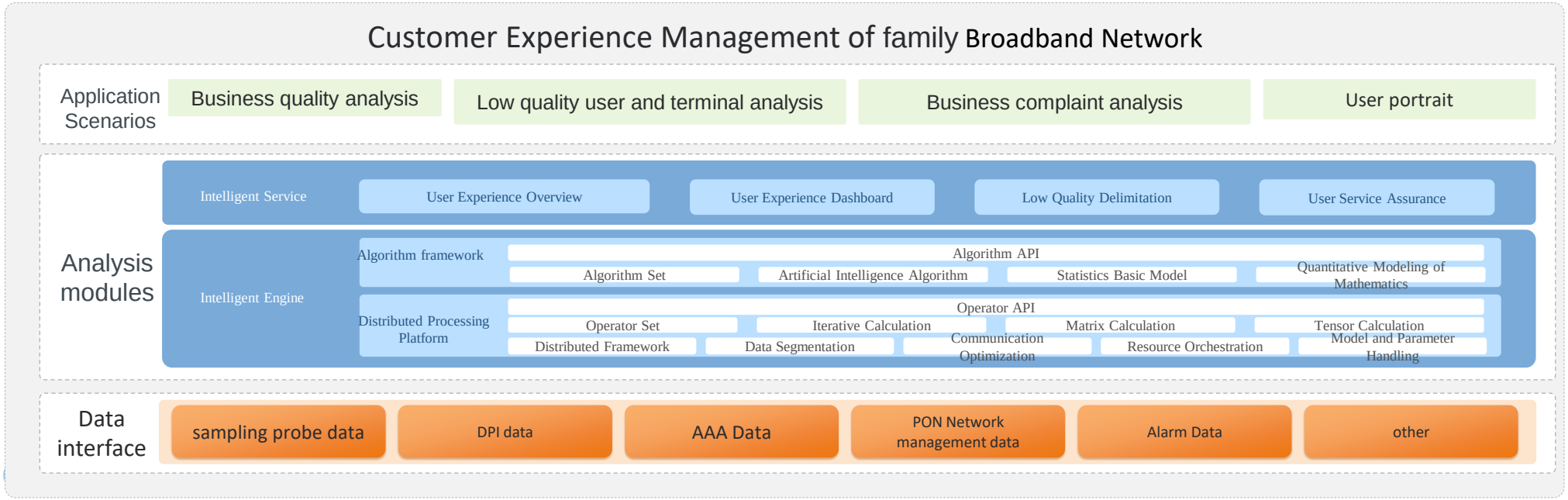
The perception evaluation system was established to analyze users' overall perception and experience of family broadband network, including business, network and service dimensions.

Low Quality Delimitation

Tracking the changes of users' customer perception, analyzing the site of perceived quality degradation of users in business and network, and then conducting layer by layer decomposition and definition.

Proactive Repairation

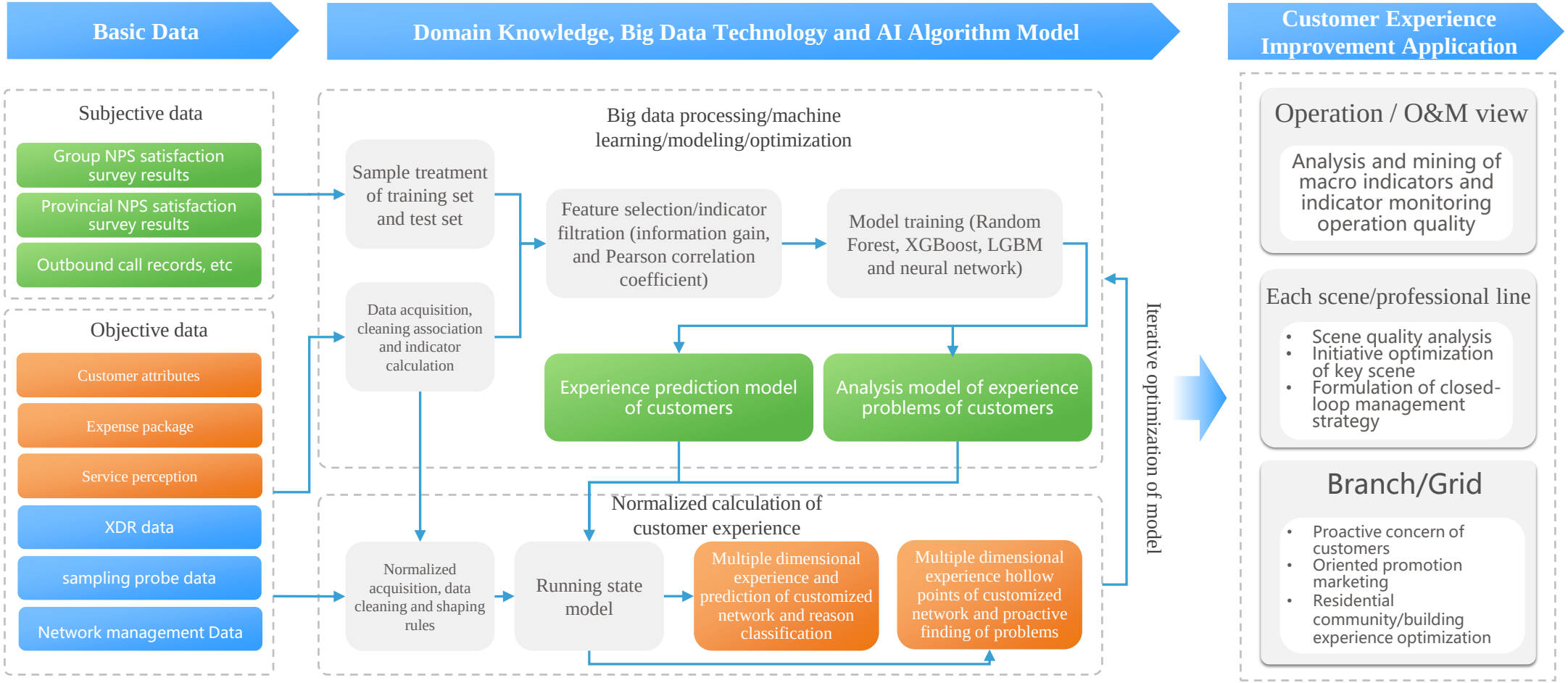
With B/O domain data fusion analysis, proactively repair the root cause of user perception degradation in network and service, complete the closed loop management of customer perception, then improve user's satisfaction.



Functional Architecture

Solution Details

Based on big data analysis technology and machine learning algorithm, establishes the multi-dimensional customer perception analysis model and evaluation system of family broadband network. With customer satisfaction survey data as the training sample set, the model is iterated constantly to optimize the evaluation system.

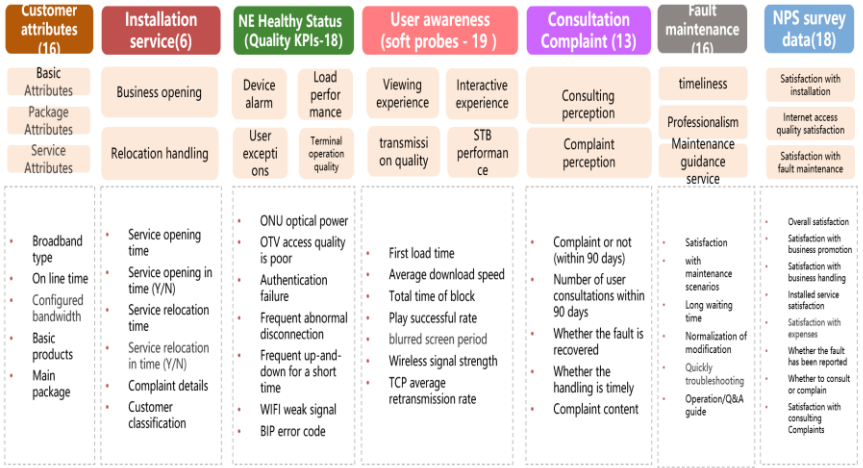


Serial example

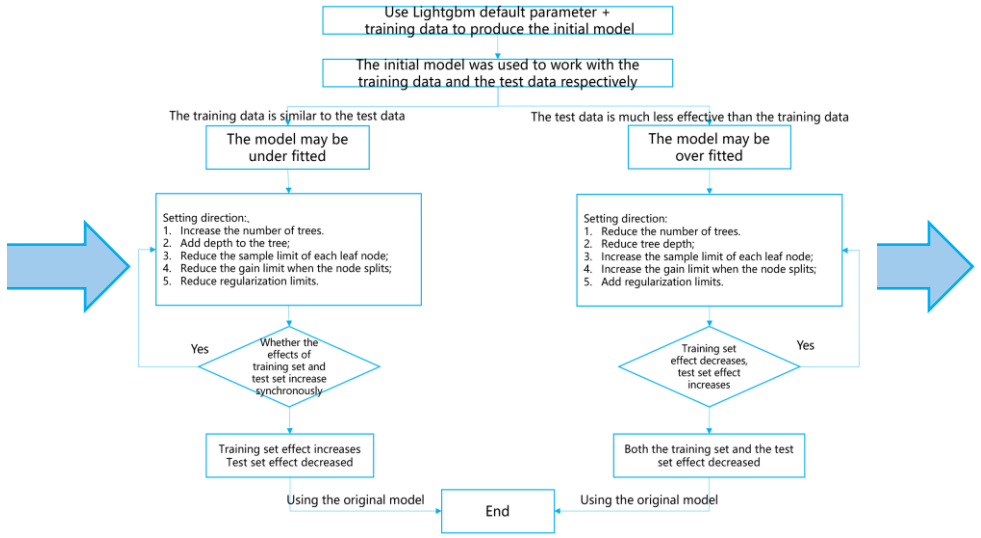
In family broadband satisfaction prediction scenario, machine learning algorithm is used to analyze and model cross-domain data, and explores the internal relationship between subjective experience data (NPS) and objective customer perception (network quality, usage perception, package fee). The machine learning platform is used to continuously strengthen training. Finally, converges the available model, hence finds the potential unsatisfied customers.

Initial model tuning

At the initial stage of system construction, the model is affected by data, algorithms, data quality, etc., and the recall and precision are not high.

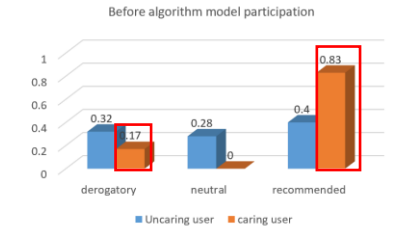


Model training and tuning



Model convergence

Before algorithm model participation



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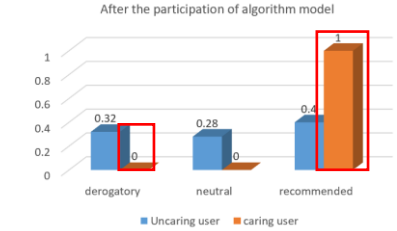


Based on big data, proactively selecting "potentially dissatisfied users" of family broadband access online category for care restoration can also better improve the overall satisfaction of the target user group. As can be seen from the two charts, the satisfaction of users who have conducted active care has increased by **17%**, with obvious effect.

System environment of Demo

➢ Hardware environment

Intel® Xeon® Gold 6330N @ 2.20GHz
2 CPUs (NUMA) x 28 cores x 2 hyper-threads
Intel® Hyper-Threading Technology: on
Intel® Turbo Boost Technology: on
Intel® Ethernet Controller XXV710 25GbE

➢ software environment

Intel ® distribution of Python
Intel ® Optimized Scikit-learn
Intel ® Optimized XGBoost
Intel ® OneDAL
Intel ® OneDNN

Demo

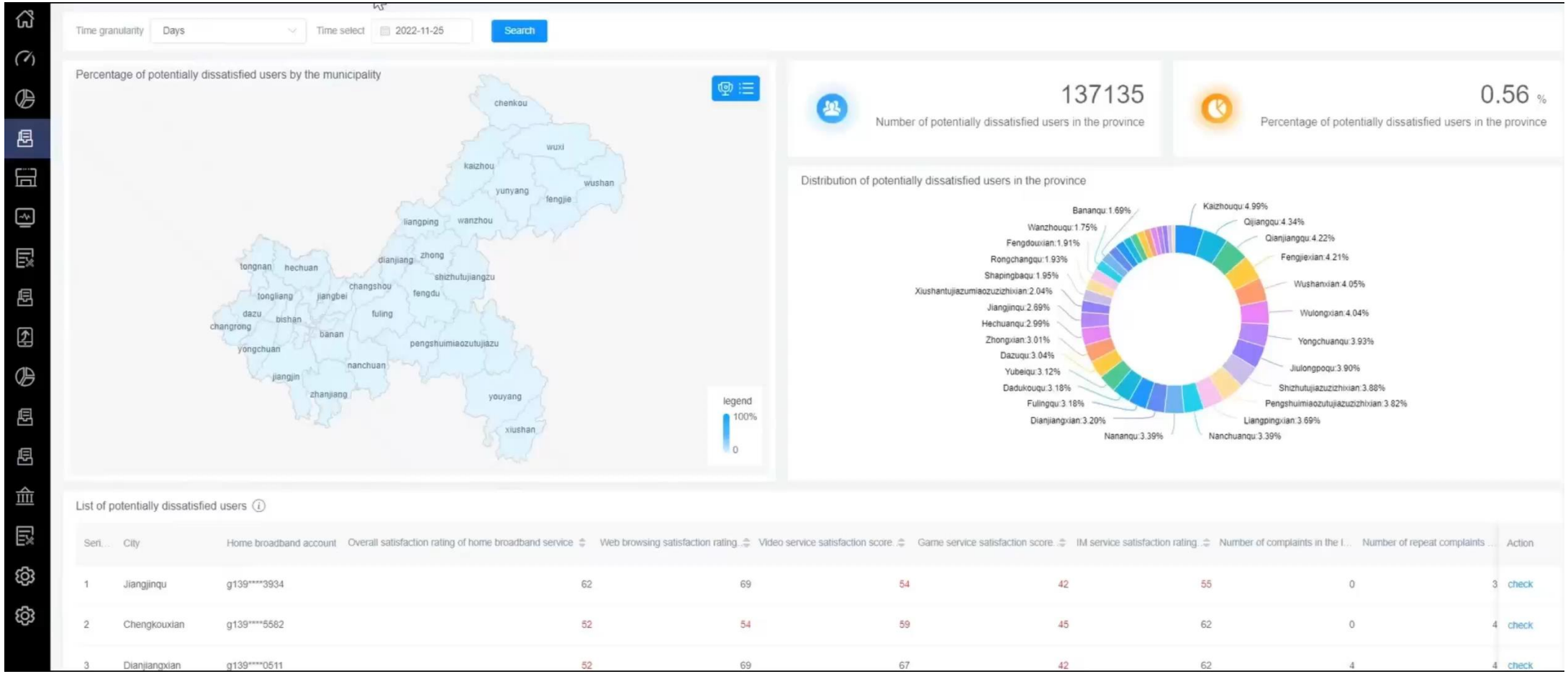


Table of Contents

Contribution: supplement to ENI Use case 3-8

In the meeting of ENI-RappCall # 242, Asiainfo and Intel contributed proposal of ENI (23) 000_047r1, to be used to supplement ENI 001 case 3-8. The contribution added mapping relationship between PoC architecture and ENI architecture, and flow of information.

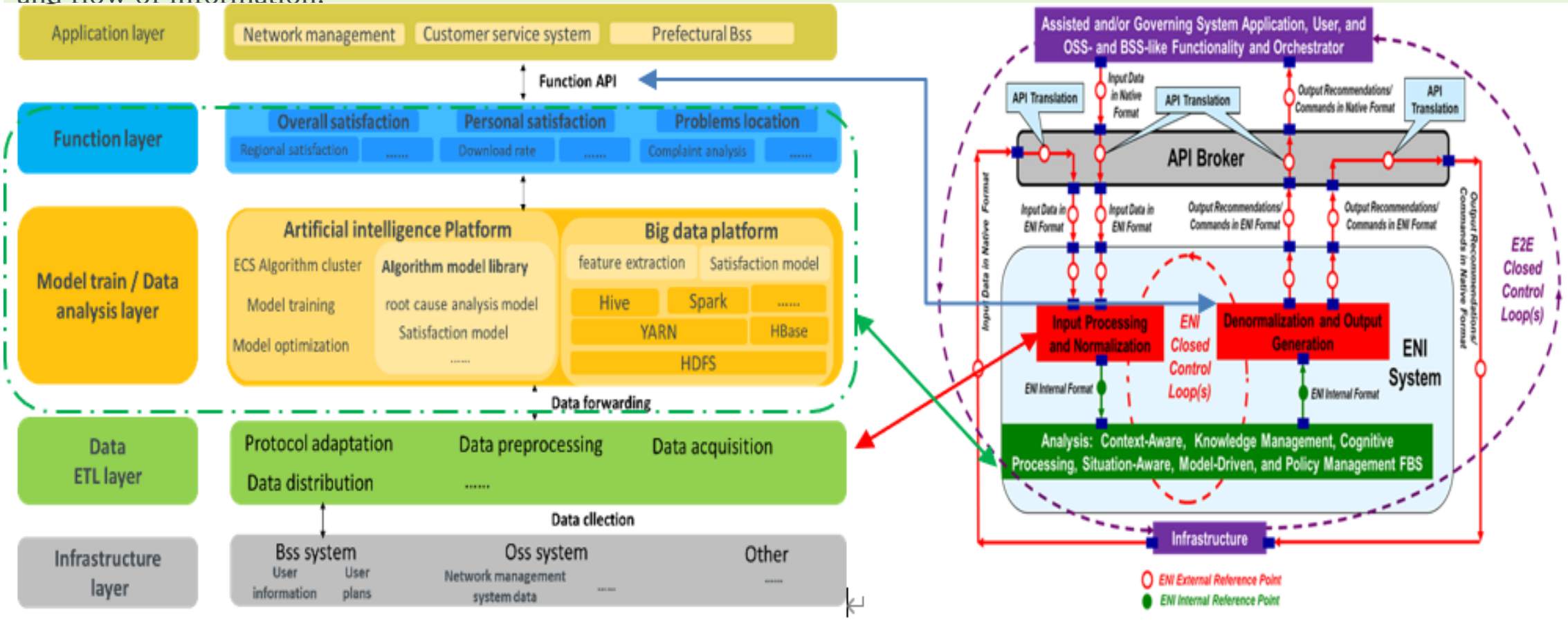


Figure : Mapping to ENI reference architecture

Contribution: supplement to ENI Use case 3-8

Step 1: Infrastructure layer sends massive historical data to data ETL layer.
Step 2: The data ETL layer normalizes the data and sends the data to the model train and data analysis layer.
Step3: The model train and data analysis layer process normalization data and a generates user experience model.
Step4: Infrastructure layer sends periodic data to data ETL layer.
Step5: The data ETL layer normalizes the data and sends the data to the model train and data analysis layer.
Step6: after learning, model train and data analysis layer have generates atomic capabilities for customer experience optimization and encapsulates these atomic capabilities in the functional layer.
Step6a: when the model train and data analysis layer call the existing knowledge can not understands the normalizes periodic data, it will analyzes and learns periodic data to optimize the customer experience optimization model.
Step7: Functional layer 's atomic capabilities are ready to be used the via functional layer API.
Step8: Application layer implements capability call via functional API .

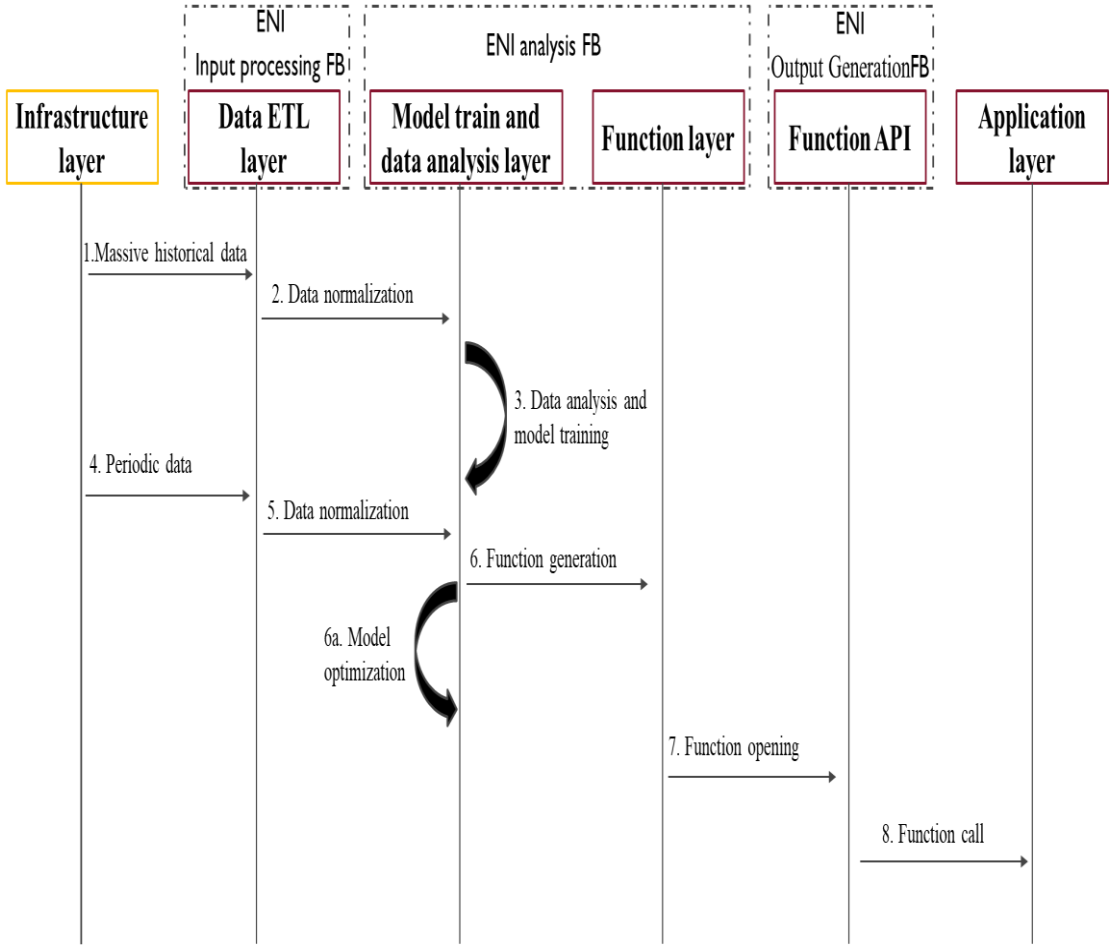
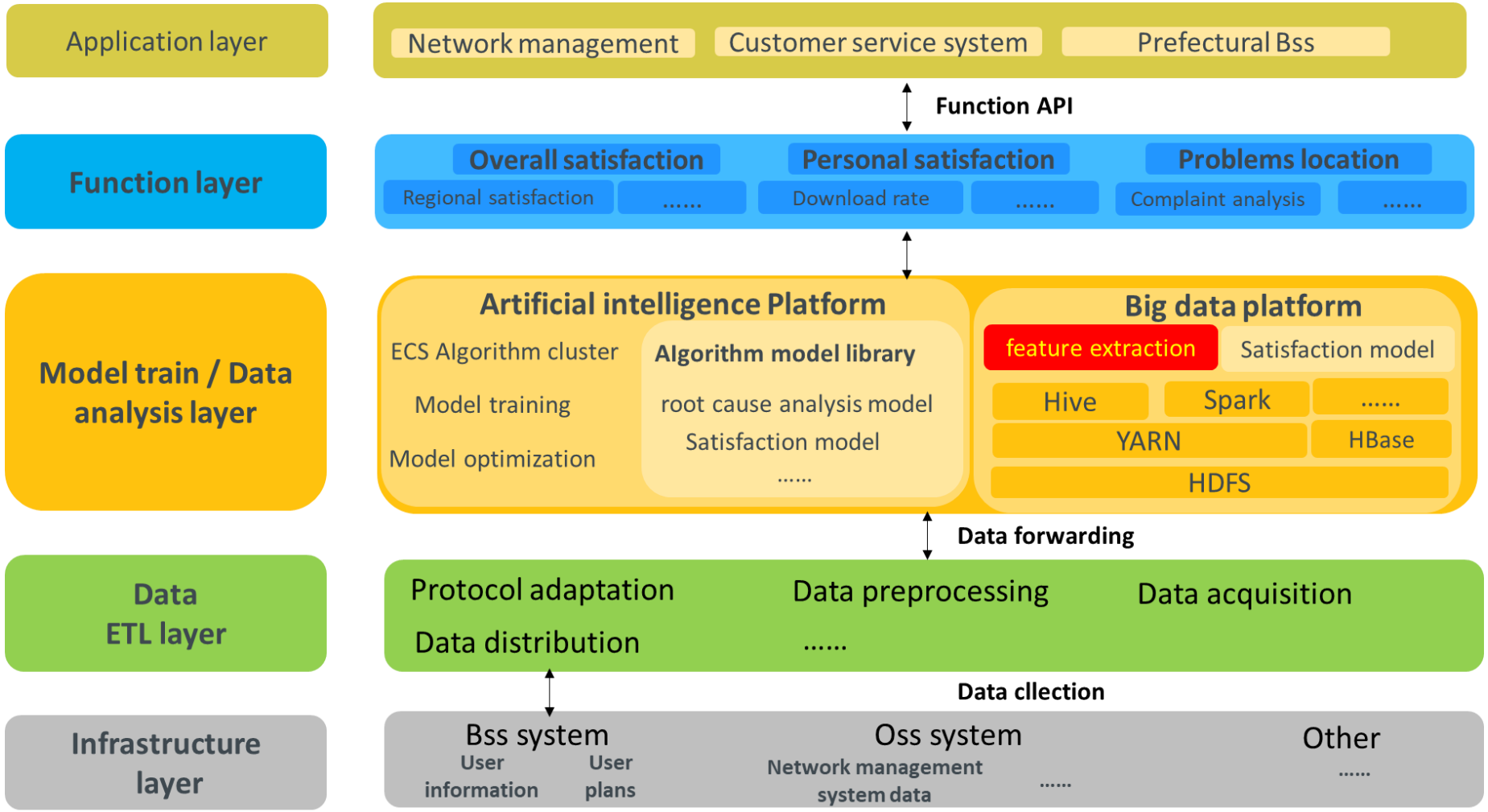


Figure : flow of information

Optimization of PoC architecture

The architecture of POC was optimized. The feature extraction function block was added in the big data platform. As show the red function block.



Promotion of PoC application

The successful practice of PoC in Chongqing has promoted operators' interest. The following figures show the promotion situation in Guizhou Province. The main construction contents include the analysis of satisfaction of family broadband, the analysis of end-to-end quality of business and the analysis of Internet TV.

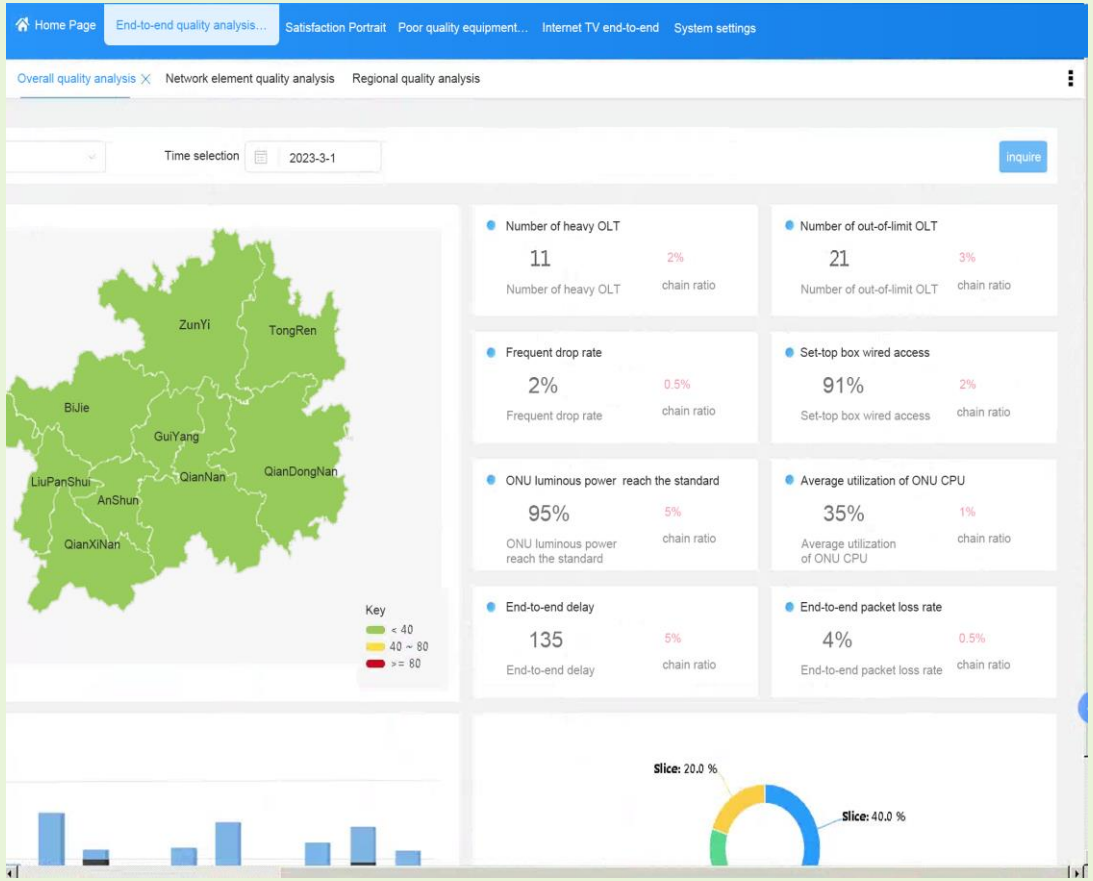


Figure: Overall quality analysis

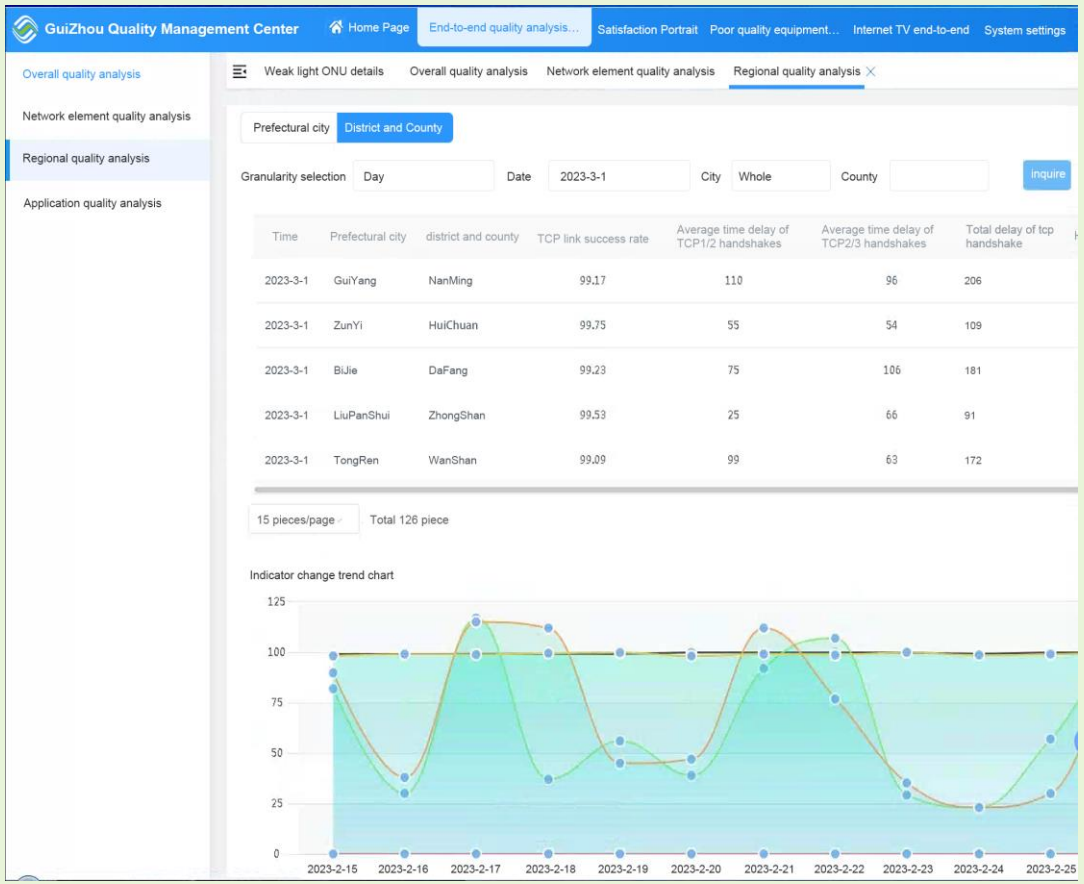


Figure: Regional quality analysis

Promotion of PoC application

The dashboard shows user's personal package information, network information and experience rating information.

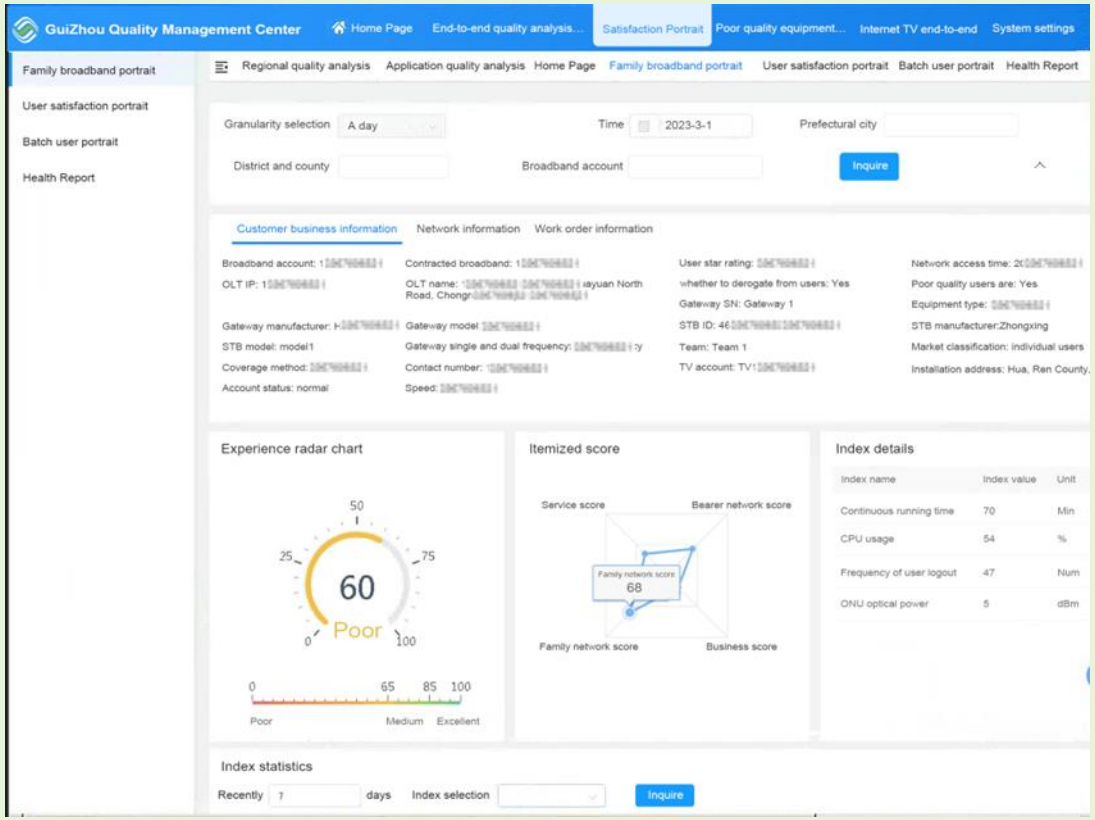


Figure User satisfaction portrait

The dashboard shows the business operation trend information of Internet TV network hardware equipment, etc.

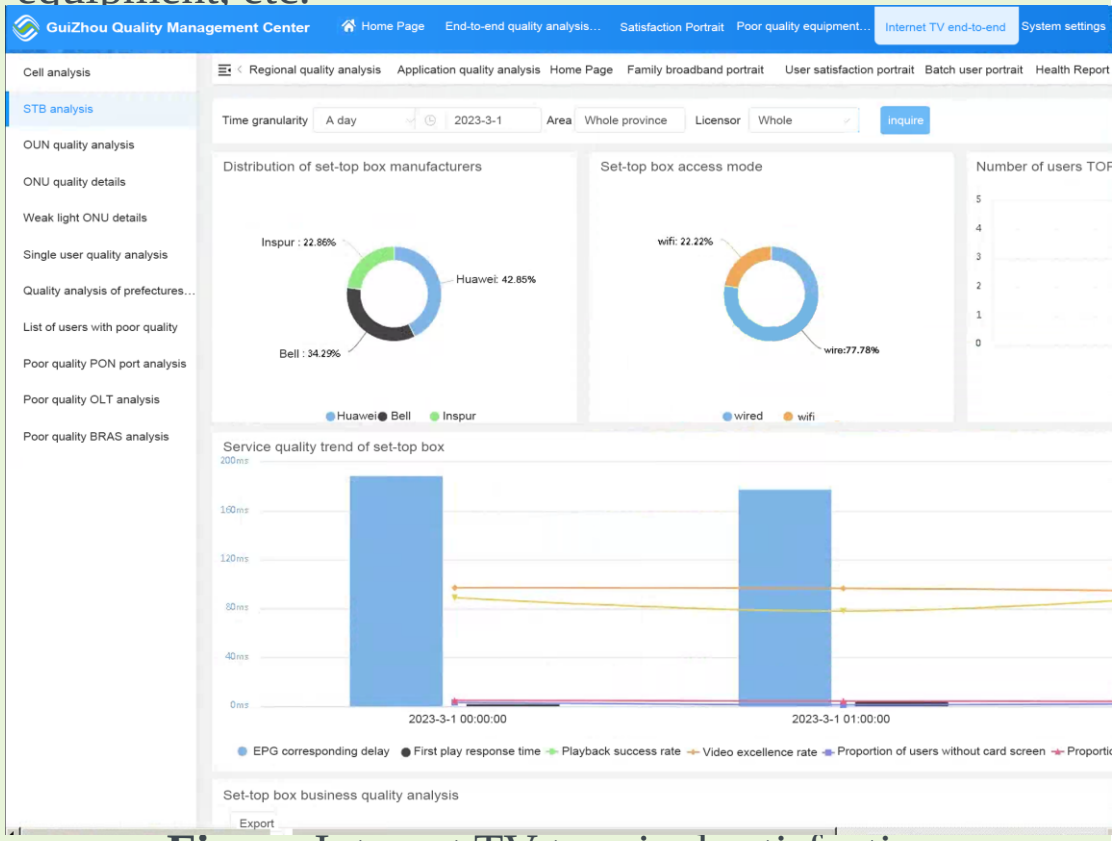


Figure Internet TV terminal satisfaction

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