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Huawei GENEX Discovery Big Data tool for wireless network analysis

In this article was described system for monitoring the status and analysis of wireless network. Subsystems of solution were described with possible data feeds from different data sources including Huawei U2000, DGW, NetProbes, Trace server, SAU. Supported features for each generation of wireless network have been studied. Each of functions can provide statistics for cell or base station from network point, neighbor cell, grid, location, vendor equipment or even user terminal point of view in real time. More details were provided on features such as Network Health Evaluation, Coverage Analysis. Network Health Evaluation provides evaluation functions at the macro level, including network-level evaluation and area-level evaluation. The network-level evaluation function evaluates a network from multiple dimensions such as coverage, performance, traffic and scores the heath of the network in combination with geographic observation results, which helps users quickly understand the network status and trend. The area-level evaluation function scores the health of each evaluated area on a network. It helps users quickly identify problem areas. The area-level evaluation function allows users to set some areas as valuable areas, where quality counter greatly affects the health score of the areas and entire network. Coverage Analysis analyzes and displays the coverage analysis results on maps based on the MRs reported by common subscribers' mobile phones, thereby helping operators to evaluate network coverage comprehensively and at low costs and identify problems such as weak coverage and overshoot coverage. Conclusions were made about the possibility of GENEX Discovery data integration with other data analysis tools or machine learning: Applications can be used to trouble-shoot and analyze wireless network; Due to architecture similarities system can be co-deployed with Huawei SmartCare to extend both systems capabilities; Data from GENEX Discovery can be exported to other data analysis or ML tools by DSI service; 5G wireless network analysis is supported, which allow to analyze IoT data from Smart City;

Keywords: GSM; UMTS; LTE; 5G; wireless network; Big Data; ML.

Introduction

Humanity during its evolution has developed different ways to store and transport information. Right now, messages, videos, pictures are transferred though different environments like copper wire, optical fiber, wireless. Wireless is used by mobile subscribers, who's moving during data transmission all the time. Radio access network is very unstable due to its nature.

How to manage such environment?

How to define what is root cause for signal attenuation?

Which message BSC, RNC, eNodeB or any other wireless access network to subscriber's device?

Why base station has sent a message to use specific type of voice codec during channel establishment?

How to optimize cell coverage, cell transmission wavelength or which modulation is more preferable for following site?

The main part

GENEX Discovery is a wireless network geographic observation and analysis platform. Based on network big data, accurate geographic location algorithms, and Huawei's global experience, system automatically identifies and analyzes wireless network performance issues, and improves network planning and optimization efficiency [1].

The Discovery obtains NE lists, NE configuration data, and performance data from Huawei OSS U2000. When the Trace Server is deployed, the solution can obtain CHR and MR data generated by Huawei RNCs (BSCs), NodeBs, eNodeBs, and mobility management entities (MMEs) from the Trace Server. When no Trace Server is deployed, the Discovery obtains CHR and MR data from the service aware unit (SAU) boards in Huawei RNCs (BSCs). In addition, the system obtains the data (configuration data, traffic data, CHR data, and MR data) generated by competitors' NEs from the data gateway (DGW). This function is used to configure and collect the basic information (for example, accounts and IP addresses) of external systems, such as the OSS, Trace Server, RNC SAU boards, and DGW. The basic information is used for command and data interaction between the Discovery and external systems. The Discovery supports setting of the collector. The IP addresses, port numbers, and protocol types of the collection objects can be configured for data collection.

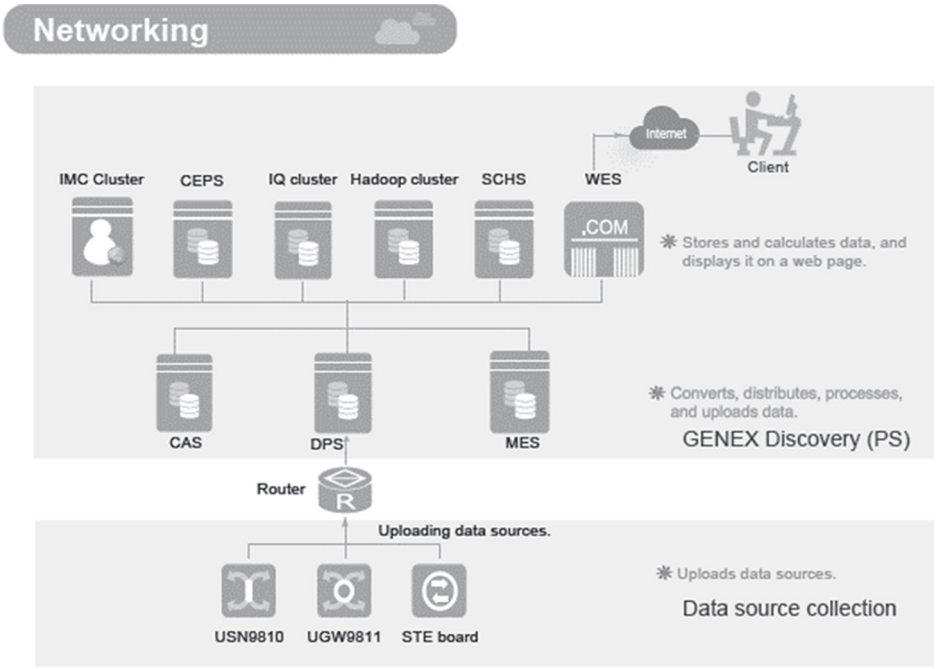
Source data subscription function is used to deliver data subscription commands (which directly control NEs to generate related data, such as controlling the NE sets that report CHR and MR data and controlling the specific types of data blocks reported by NEs) to Huawei NEs. This function is also used to deliver data subscription commands for obtaining competitors' device data to the DGW (users need to configure data on OSSs of competitors' devices). Therefore, users can obtain the CHR and MR data used for various service features [2].

Discovery supports to receive and preprocess data from external, internal, and third-party probes, and converts from external data formats to internal data formats. Supported data sources include Huawei PS probe, Huawei CS probe, Huawei CHR/MR, DGW, and third-party probes [3].

The GENEX Discovery system consists of the following physical entities:

- Web server (WES) provides real-time surveillance service report analysis, historical data analysis, and multi-dimensional data drilldown. Provides functions such as log management and alarm management.
- Schedule server (SCHS) provides functions such as task management & scheduling and metadata management.
- Hadoop server (HDPS) stores all CDRs and simplified CDRs and calculates daily SDRs.
- Sybase IQ cluster loads, computes, and stores service detail records (SDRs)
- Complex event processing server (CEPS) associates complex events and simplifies CDRs.
- In memory computing (IMC) cluster calculates basic KPIs and SDRs and flexibly supports various upper-layer applications.
- Correlation analysis server (CAS) resolves and consolidates CDRs into formats that can be recognized by the upper-layer modules.
- Mediation server (MES) converts built-in data sources (CHRs, UFDRs, and xDRs) into formats that can be recognized by the system.
- Distribute processing server (DPS) functions as the dispatching unit that receives call history data and distributes it to different servers.

The positions of physical entities on the network can be adjusted based on the network bandwidth. Figure shows the networking diagram of GENEX Discovery [3].



Typical networking of the GENEX Discovery system

GENEX Discovery support 2G, 3G, 4G wireless network analysis. Table 1 describes features for each wireless network generation.

Most of features support analysis based on counters, sub-counters. Analysis can be done based on grid, location, cell level, polygon or network equipment and can be filtered on map layer based on 4 basic counters with basic algorithm logic, including «and», «greater than», «less than», and «equal to». Data can be present in hourly, daily granularity with selected time range within 14 days for daily granularity or 8 days for hourly granularity. Results can be exported by user.

Table 1

2G, 3G, 4G wireless network features provided by GENEX Discovery

Network type	Supported features
GSM	Key Road Evaluation, Traffic Analysis, Coverage Analysis, Frequency Analysis, Neighboring Cell Analysis, UMTS Neighboring Cell Analysis, Uplink Interference Analysis, Network Performance Analysis, User Group Analysis (RAN), Single User Analysis (RAN), Terminal Inventory Analysis (RAN), Problem Cause Statistics
UMTS	Network Health Evaluation, Problem Area Recognition, Key Road Evaluation, Traffic Analysis, Coverage Analysis, Pilot Pollution Analysis, Intra-Frequency Neighboring Cell Analysis, Inter-Frequency Neighboring Cell Analysis, GSM Neighboring Cell Analysis, Uplink Interference Analysis, Network Performance Analysis, User Group Analysis (RAN), Single User Analysis (RAN), Terminal Inventory Analysis (RAN), Problem Cause Statistics
LTE FDD	Network Health Evaluation, Problem Area Recognition, Key Road Evaluation, High-speed Rail Evaluation, Traffic Analysis, Coverage Analysis, Overlapped Coverage Analysis, Intra-Frequency Neighboring Cell Analysis, Inter-Frequency Neighboring Cell Analysis, PCI Check, Network Performance Analysis, User Group Analysis (RAN), Single User Analysis (RAN), Terminal Inventory Analysis (RAN), NE Configuration Check, Problem Cause Statistics
LTE TDD	Network Health Evaluation, Problem Area Recognition, Key Road Evaluation, High-speed Rail Evaluation, Traffic Analysis, Coverage Analysis, Overlapped Coverage Analysis, Intra-Frequency Neighboring Cell Analysis, Inter-Frequency Neighboring Cell Analysis, PCI Check, Network Performance Analysis, User Group Analysis (RAN), Single User Analysis (RAN), Terminal Inventory Analysis (RAN), NE Configuration Check, Problem Cause Statistics

Table 2 provides detailed description of GSM, UMTS and LTE most commonly used features by mobile carrier O&M wireless team [3; 4].

Table 2

Most common used GENEX Discovery features by mobile carrier O&M wireless team

Name	Summary	Description
SGNDFD-500010 GSM Network Health Evaluation	This feature provides network evaluation functions at the macro level, including network-level evaluation and area-level evaluation. The network-level evaluation function evaluates a network from multiple dimensions, including coverage, performance, and traffic, and scores the heath of the network in combination with geographic observation results. This helps users quickly understand the network status and trend. The area-level evaluation function scores the health of each evaluated area on a network, helping users quickly identify problem areas. Users can set some areas as valuable areas. The counter quality in the valuable areas greatly affects the health score of the areas and entire network	This feature provides the following functions: • Scores health from the coverage, performance, and traffic dimensions. This feature scores health based on the following predefined sub-items, sub-counters, and atomic counters: • Coverage • Downlink coverage: Poor DL RxLev MR Ratio, Poor DL Intf MR Ratio, and Poor DL RxQual MR Ratio • Uplink coverage: Poor UL RxLev MR Ratio, Poor UL Intf MR Ratio, and Poor UL RxQual MR Ratio • Performance • Accessibility: Call Setup Success Ratio • Retainability: TCH Call Drop Ratio • Mobility: HO Success Rate • Traffic • CS Traffic Variation Rate • Evaluates network-wide health and identifies the top-N problem polygons. • Allows users to specify the time period, vendor (Huawei), service type (CS), and frequency band (ALL, GSM900, DCS1800) for health evaluation. • Displays network-wide health scores (in percentage points), and the values and trends (within the last seven days) of sub-items, such as coverage, performance, and traffic. • Allows users to view the trend (within the last seven days), sub-counter values, and top-5 problem polygons. • Allows users to view the hourly trend of a specified sub-counter. • Allows users to view the hourly trend of each sub-counter for one of the top-5 problem polygons, and the list of top-10 problem areas in the polygon. This feature can direct users from an hourly trend chart to related network analysis features. For a top-10 problem area, this feature can direct users to the Problem Area Recognition feature for further query and analysis in this area. • Evaluates the health valuable areas and identify problem polygons. • Collects statistics on the health scores and sub-counter values of a specified group of polygons, and displays the statistical results on maps.

Continuation of table 2

Name	Summary	Description
		• Allows users to view the value trend (within the last seven days), sub-counter (for example, accessibility, retainability, and mobility) values, and grid-level distribution of a specified sub-item (for example, performance). • Allows users to view the hourly trend and top-10 problem areas of each atomic counter based on a specified sub-counter. This feature can direct users from an hourly trend chart to related network analysis features. For a top-10 problem area, this feature can direct users to the Problem Area Recognition feature for further query and analysis in this area. • Immediately calculates the values of sub-counters in a temporary area specified on a grid map. • This feature generates network health evaluation reports based on the specified time period, vendor, RAT, service type, frequency, and polygon, and allows users to export the reports
SGNDFD-500040 GSM Coverage Analysis	This feature analyzes coverage and displays the coverage analysis results on maps based on the MRs reported by common subscribers' mobile phones, thereby helping operators evaluate network coverage comprehensively and at low costs and identify problems such as weak coverage and overshoot coverage	This feature provides the following functions: • Collects statistics on and analyzes the following basic coverage counters: – DL RxLev(All MRs) – DL RxLev(1st MR) – DL RxLev(Last MR) – DL Poor Quality Percentage (All MRs) – DL Poor Quality Percentage (1st MR) – DL Poor Quality Percentage (Last MR) – DL Weak Coverage Percentage – DL Interference Percentage – DL Weak Coverage and Poor Quality Percentage – DL Path Loss – UL RxLev(All MRs) – UL RxLev (1st MR) – UL RxLev (Last MR) – UL Poor Quality Percentage (All MRs) – UL Poor Quality Percentage (1st MR) – UL Poor Quality Percentage (Last MR) – UL Weak Coverage Percentage – UL Interference Percentage – UL Weak Coverage and Poor Quality Percentage – UL Path Loss – No Primary Serving Cell Percentage – Average TA – UL and DL Balance – Over Shooting MR Rate – Dominant Cell Counters related to receive level are used to identify weak coverage and counters related to receive quality are used to identify interference. The first-MR counters are collected based on the first MR of each call after the call is connected, and can be used to analyze access failures or overlong access delays. The last-MR counters are collected based on the last MR of each call before the call is terminated, and can be used to analyze abnormally released calls. All-MR counters are collected based on all the MRs of each call. The preceding three types of counters are used to identify the coverage upon initial access, coverage upon abnormal release, and network-wide average coverage, respectively. • Collects statistics on and analyzes cell-level coverage counters and identifies top-N poorly-covered cells. • Displays the coverage of a single cell on maps and allows users to check whether overshoot coverage or insufficient coverage occurs in the cell. • Collects statistics on and analyzes TRX counters of a single cell to help users check whether a problem is caused by a specific frequency. • Supports grid-level statistics and geographic observation for network-wide coverage counters and coverage analysis. In addition, it allows users to switch to the Google Map layer to analyze actual geographic environment factors and check whether coverage is affected by clutters, terrains, and buildings.

Continuation of table 2

Name	Summary	Description
		• Analyzes listed coverage grids, identifies and lists poorly-covered grids, and displays the information about the poorly-covered grids synchronously on maps. This helps users quickly locate and analyze the poorly-covered grids. • Analyzes the PDF and CDF charts for the coverage level, receive level and receive quality counters of a specified grid or cell. • Analyzes the cells related to a specified grid. • This feature collects statistics on the top-5 correlated cells of a specified grid or polygon and connects the grid or polygon to its top-5 correlated cells. In addition, this feature allows users to view the information about each top-5 correlated cell. The information includes the PDF and CDF charts for receive level and receive quality counters, engineering parameters, and others. • Distinguishes between indoor and outdoor coverage and supports indoor coverage-only maps, outdoor coverage-only maps, and indoor-outdoor coverage maps. • Supports the display and correlated update of multiple charts. • This function allows users to view a maximum of four map panes simultaneously and supports the correlated update of these map panes. • Filters map layer information based on multiple specified counters: – Supports a maximum of four counters with basic algorithm logic, including "and", "greater than", "less than", and "equal to." • Analyzes overshoot coverage based on a specified cell group and time period, including the following functions: – Cell-level statistics analysis calculates the percentage of overshoot coverage grids in each specified cell, helping identify the top-N overshoot coverage cells. This function also provides the information about each cell. The information includes the percentage of overshoot coverage grids, maximum overshoot coverage call distance, average overshoot coverage distance, percentage of overshoot coverage calls, total number of calls, and others. – Overshoot coverage geographic observation displays the overshoot coverage MR ratio of each grid and the grid-level distribution of overshoot coverage in a specified cell, helping users understand overshoot coverage in the cell. – Grid-level statistics analysis displays the receive level for each cell
SGNDFD-200010 UMTS Network Health Evaluation	This feature provides network evaluation functions at the macro level, including network-level evaluation and area-level evaluation. The network-level evaluation function evaluates a network from multiple dimensions, including coverage, performance, and traffic, and scores the heath of the network in combination with geographic observation results. This helps users quickly understand the network status and trend. The area-level evaluation function scores the health of each evaluated area on a network, helping users quickly identify problem areas. Users can set some areas as valuable areas. The counter quality in the valuable areas greatly affects the health score of the areas and entire network.	This feature provides the following functions: • Scores health from the coverage, performance, and traffic (only for Huawei networks) dimensions. This feature scores health based on the following predefined sub-items, sub-counters, and atomic counters: • Coverage • Coverage Level: Poor RSCP Ratio • Coverage Quality: Poor Ec/No Ratio • Pilot pollution: Pilot Pollution Ratio • Performance • Accessibility: – CS: AMR RAB Setup Success Ratio and VP RAB Setup Success Ratio – PS: PS R99 RAB Setup Success Ratio, HSDPA RAB Setup Success Ratio, HSUPA RAB Setup Success Ratio, and HSPA RAB Setup Success Ratio • Retainability: – CS: AMR Call Drop Ratio and VP Call Drop Ratio – PS: R99 Call Drop Ratio, HSUPA Call Drop Ratio, HSDPA Call Drop Ratio, and HSPA Call Drop Ratio • Mobility: SHO Success Ratio, HHO Success Ratio, and Inter-RAT HO Success Ratio • Traffic (only for Huawei networks) • CS Traffic Variation Ratio • PS Traffic Variation Ratio • Evaluates network-wide health and identifies the top-N problem polygons: – Allows users to specify a time period, vendor (Huawei, Ericsson, or Nokia), service type (CS, PS, or all), and frequency for health evaluation.

Continuation of table 2

Name	Summary	Description
		– Displays network-wide health scores (in percentage points), and the values and trends (within the last seven days) of sub-items, such as coverage, performance, and traffic (only for Huawei networks). – Allows users to view the trend (within the last seven days), sub-counter values, and top-5 problem polygons of a specified sub-item. (RSCP is short for received signal code power and Ec/No is short for ratio of energy per modulating bit to the noise spectral density.) – Other feature capabilities are same as for SGNDFD-500010 GSM Network Health Evaluation
SGNDFD-200040 UMTS Coverage Analysis	This feature analyzes coverage and displays the coverage analysis results on maps based on the MRs reported by common subscribers' mobile phones, thereby helping operators evaluate network coverage comprehensively and at low costs and identify problems such as weak coverage and overshoot coverage.	This feature provides the following functions: • Collects statistics on and analyzes the following basic coverage counters: – Best Pilot RSCP (1st MR) – Best Pilot RSCP (Last MR) – Best Pilot RSCP (All MRs) – Best Pilot Ec/No (1st MR) – Best Pilot Ec/No (Last MR) – Best Pilot Ec/No (All MRs) – DL Weak Coverage Percentage – DL Poor Quality Percentage – DL Weak Coverage and Poor Quality Percentage – DL Interference Percentage – Active1 RSCP (All MRs) – Active2 RSCP (All MRs) – Active3 RSCP (All MRs) – Active1 Ec/No (All MRs) – Active2 Ec/No (All MRs) – Active3Ec/No (All MRs) – Dominant Cell – Average Active Cell Count – Over Shooting Grid Rate – Except for Over Shooting Grid Rate, all the preceding counters can be used to analyze services of the CS, PS, or ALL type. Over Shooting Grid Rate can be used to analyze only services of the ALL type. RSCP-related counters are used to identify weak coverage and Ec/No-related counters are used to identify interference. The first-MR counters are collected based on the first MR of each call after the call is connected, and can be used to analyze access failures or overlong access delays. The last-MR counters are collected based on the last MR of each call before the call is terminated, and can be used to analyze abnormally released calls. All-MR counters are collected based on all the MRs of each call. The preceding three types of counters are used to identify the coverage upon initial access, coverage upon abnormal release, and network-wide average coverage, respectively. Counters related to ActiveSet 1, 2, or 3 can be used to analyze whether soft handover planning is proper (namely, whether the soft handover gain and capacity redundancy consumption cost are balanced). • Feature capabilities for UMTS analysis are same as SGNDFD-500040 GSM Coverage Analysis
SGNDFD-300010 LTE FDD Network Health Evaluation; SGNDFD-400010 LTE TDD Network Health Evaluation	This feature provides network evaluation functions at the macro level, including network-level evaluation and area-level evaluation. The network-level evaluation function evaluates a network from multiple dimensions, including coverage, performance, and traffic, and scores the heath of the network in combination with geographic observation results. This helps users quickly understand the network status and trend.	This feature provides the following functions: • Scores health from dimensions, such as coverage (weak coverage and overlapped coverage), performance (access failure, call drop, and handover failure), and traffic (traffic variation, only for Huawei networks). This feature scores health based on the following predefined subitems, sub-counters, and atomic counters: • Coverage • Uplink weak coverage (only for Huawei networks): High UE TX-Power Ratio, UL Poor RSRP Ratio, and UL Poor SINR Ratio • Downlink weak coverage: DL Poor RSRP Ratio and DL Poor RSRQ Ratio • Overlapped coverage • Performance

The end of table 2

Name	Summary	Description
	Users can set some areas as valuable areas. The counter quality in the valuable areas greatly affects the health score of the areas and entire network.	• Retainability: Call Drop Ratio • Mobility: Handover Success Ratio • Traffic (only for Huawei networks) • PS Traffic Variation • Evaluates network-wide health and identifies the top-N problem polygons: – Allows users to specify the time period, vendor (Huawei, Ericsson, and Nokia), and frequency band for health evaluation. – Geographically displays abnormal events for VIP subscribers on the level-1 performance scoring page. – Other feature capabilities are same as for SGNDFD-500010 GSM Network Health Evaluation
SGNDFD-300040 LTE FDD Coverage Analysis; SGNDFD-400040 LTE TDD Coverage Analysis	This feature analyzes coverage and displays the coverage analysis results on maps based on the MRs reported by common subscribers' mobile phones, thereby helping operators evaluate network coverage comprehensively and at low costs and identify problems such as weak coverage and overshoot coverage.	This feature provides the following functions: • Collects statistics on and analyzes the following basic coverage counters: • RSRP(All MRs) • RSRQ(All MRs) • RSRP(1st MR) • RSRQ(1st MR) • RSRP(Last MR) • RSRQ(Last MR) • DL Weak Coverage Percentage • DL Poor Quality Percentage • DL Weak Coverage and Poor Quality Percentage • DL Interference Percentage • UE TxPower(All MRs) (Huawei only) • UL DM RSRP(All MRs) (Huawei only) • UL DM RS SINR(All MRs) (Huawei only) • UE TxPower(1st MR) (Huawei only) • UL DM RSRP(1st MR) (Huawei only) • UL DM RS SINR(1st MR) (Huawei only) • UE TxPower(Last MR) (Huawei only) • UL DM RSRP(Last MR) (Huawei only) • UL DM RS SINR(Last MR) (Huawei only) • UL Weak Coverage Percentage • UL Poor Quality Percentage • UL Weak Coverage and Poor Quality Percentage • UL Interference Percentage • Over Shooting Grid Rate • Dominant Cell RSRP-related counters are used to identify weak coverage and RSRQ-related counters are used to identify interference. (RSRP is short for reference signal received power and RSRQ is short for reference signal received quality.) First-MR counters are collected based on the first MR of each call after the call is connected. All-MR counters are collected based on all the MRs of each call. The preceding types of counters are used to identify the coverage upon initial access and the network-wide average coverage. • Feature capabilities for LTE TDD/FDD analysis are same as SGNDFD-500040 GSM Coverage Analysis

Conclusions

1. GENEX Discovery is a powerful tool for RAN analysis. System allows to check coverage level and frequency division on different levels, counters, sub-counters, etc.

2. Solution has same subsystem entities and elements as another Huawei solution SmartCare [5]. Discovery supports same NetProbes as SmartCare. In such case I can make assumption, that both systems can be integrated or even co-deployed on one and same hardware. Such approach can expand mobile carrier capabilities for better customer experience.

3. Based on conclusion 2, DSI (Data share interface) can be added to GENEX Discovery to export data from database. Following information can be used with data analysis tools or even machine learning to develop use cases, forecasts for marketing and other analysis purposes for different targets.

4. According to [1], Discovery is part of «B.E.S.T. Network» solution, which support analysis of 5G networks. In such case assumption was made, that Discovery support analysis of 5G RAN for IoT of Smart City.

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HUAWEI GENEX DISCOVERY — ІНСТРУМЕНТ ВИЯВЛЕННЯ ВЕЛИКИХ ДАНИХ ДЛЯ АНАЛІЗУ БЕЗПРОВОДОВОЇ МЕРЕЖІ

Наведено опис системи для моніторингу статусу та аналізу радіомережі. Описано підсистеми, що входять до складу виробу з можливими варіантами передавання даних від різних джерел даних, такі як Huawei U2000, DGW, NetProbes, Trace server, SAU. Вивчено функціонал для кожного покоління мереж радіодоступу. Кожна функція може надавати статистичні дані стільника або базової станції з погляду точки мережі, мережі сусідніх стільників, розташування, обладнання виробника або навіть термінала користувача в режимі реального часу. Приділено більше уваги таким функціоналам, як Network Health Evaluation та Coverage Analysis. Network Health Evaluation надає можливість оцінювати на макрорівні, включно з оцінюванням на рівні мережі та на рівні області. Можливість оцінювання на рівні мережі передбачає оцінювання за кількома параметрами, такими як покриття, продуктивність, трафік, а також оцінює стан мережі в поєднанні з результатами географічного спостереження, що допомагає користувачам швидко зрозуміти стан мережі та тенденції. Функція оцінювання на рівні області характеризує стан працездатності кожної оцінюваної ділянки в мережі, сприяючи швидкому визначенню користувачами проблемних регіонів. Також функція дає змогу користувачам установлювати деякі області як пріоритетні, де значення лічильника якості значною мірою впливає на оцінювання працездатності інших ділянок і всієї мережі. Coverage Analysis аналізує та відображає результати аналізу покриття на мапах на основі MR, отриманих із мобільних пристроїв користувачів, у такий спосіб допомагаючи операторам всебічно та за низьких витрат оцінювати покриття мережі та виявляти такі проблеми, як слабке покриття та перекриття покриття. Було зроблено висновки щодо можливості інтеграції даних GENEX Discovery з іншими системами аналізу даних або машинним навчанням: функціонал виробу можна використовувати для усунення несправностей та аналізу безпроводової мережі; завдяки схожості архітектури, систему можна розгорнути разом із Huawei SmartCare, щоб розширити можливості обох систем; є можливість експортувати дані з GENEX Discovery в інші інструменти аналізу даних або ML за допомогою DSI сервісу; система надає підтримання мережі 5G, що дає змогу аналізувати дані IoT для Smart City;

Ключові слова: GSM; UMTS; LTE; 5G; безпроводова мережа; великі дані; ML.