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Fifth Generation Fixed Network (F5G); Architecture and data models for residential service quality monitoring

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ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - APE 7112B
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° w061004871

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Foreword

This Group Specification (GS) has been produced by ETSI Industry Specification Group (ISG) Fifth Generation Fixed Network (F5G).

Modal verbs terminology

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1 Scope

The present document defines the system architecture for residential service quality monitoring (service KQI's, network KQI's) based on ETSI GS F5G 017 [1]. The corresponding technical requirements, interfaces and data models of the system are also be specified.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at https://docbox.etsi.org/Reference.

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The following referenced documents are necessary for the application of the present document.

[1] ETSI GS F5G 017: "Fifth Generation Fixed Network (F5G); F5G Measurement Specification for Residential Services Quality Evaluation".

[2] IETF RFC 4251: "The Secure Shell (SSH) Protocol Architecture".

[3] BBF TR-069: "CPE WAN Management Protocol -- Issue: 1 Amendment 6".

[4] Recommendation ITU-T G.988: "ONU management and control interface (OMCI) specification".

[5] IEEE 802.11a™-1999: "IEEE Standard for Telecommunications and Information Exchange Between Systems - LAN/MAN Specific Requirements - Part 11: Wireless Medium Access Control (MAC) and physical layer (PHY) specifications: High Speed Physical Layer in the 5 GHz band".

[6] IEEE 802.11b™-1999: "IEEE Standard for Information Technology - Telecommunications and information exchange between systems - Local and Metropolitan networks - Specific requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications: Higher Speed Physical Layer (PHY) Extension in the 2.4 GHz band".

[7] IEEE 802.11g™-2003: "IEEE Standard for Information technology-- Local and metropolitan area networks -- Specific requirements -- Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Further Higher Data Rate Extension in the 2.4 GHz Band".

[8] IEEE 802.11n™-2009: "IEEE Standard for Information technology -- Local and metropolitan area networks-- Specific requirements -- Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications Amendment 5: Enhancements for Higher Throughput".

[9] IEEE 802.11ac™-2013: "IEEE Standard for Information technology -- Telecommunications and information exchange between systems–Local and metropolitan area networks -- Specific requirements -- Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications -- Amendment 4: Enhancements for Very High Throughput for Operation in Bands below 6 GHz".

[10] IEEE 802.11ax™-2021: "IEEE Standard for Information Technology -- Telecommunications and Information Exchange between Systems Local and Metropolitan Area Networks -- Specific Requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications Amendment 1: Enhancements for High-Efficiency WLAN".

[11] IEEE P.802.11be™: "IEEE Draft Standard for Information technology -- Telecommunications and information exchange between systems Local and metropolitan area networks -- Specific requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications Amendment: Enhancements for Extremely High Throughput (EHT)".

[12] IETF RFC 8259: "The JavaScript Object Notation (JSON) Data Interchange Format.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

Not applicable.

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the following terms apply:

data cleansing: process of detecting and correcting (or removing) corrupt or inaccurate records from a record set, table, or database

telework: practice of working from home, making use of residential internet, email, telephone, etc.

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

5G	5nd Generation (mobile networks)
AP	Access Point
BSSID	Basic Service Set Identifier
BTV	Broadband TV
CO	Central Office
CPU	Central Processing Unit
CSV	Comma-Separated Values file
DNS	Domain Name Server
E2E	End to End
E-ONU	Edge-ONU
GB	GigaByte
HTTP	Hypertext Transfer Protocol
ID	Identifier
IP	Internet Protocol
IPTV	Internet Protocol Television
JSON	JavaScript Object Notation
KPI	Key Performance Indicator

KQI	Key Quality Indicator
LAN	Local Area Network
MAC	Medium Access Control
MOS	Mean Opinion Score
OMCI	Optical Management & Control Interface
ONU	Optical Network Unit
PING	Packet Internet Groper
PLR	Packet Loss Radio
P-ONU	Primary ONU
RAM	Random Access Memory
ROM	Read-Only Memory
RSSI	Received Signal Strength Indicator
RTT	Round Trip Time
SFTP	SSH File Transfer Protocol
SSID	Service Set Identifier
SSL	Secure Socket Layer
STA	Station
TCP	Transmission Control Protocol
TLS	Transport Layer Security
TV	Television
URL	Uniform Resource Locator
UTC	Coordinated Universal Time
VOD	Video On Demand
VR	Virtual Reality

4 General requirements

4.1 Overview of framework architecture

Figure 1 shows the functional architecture of the residential service quality monitoring. The functions of the monitoring system include service KQI monitoring, network KQI monitoring and network KPI monitoring. Network KQI monitoring can be initiated through a service-oriented monitoring platform or network-oriented monitoring platform.

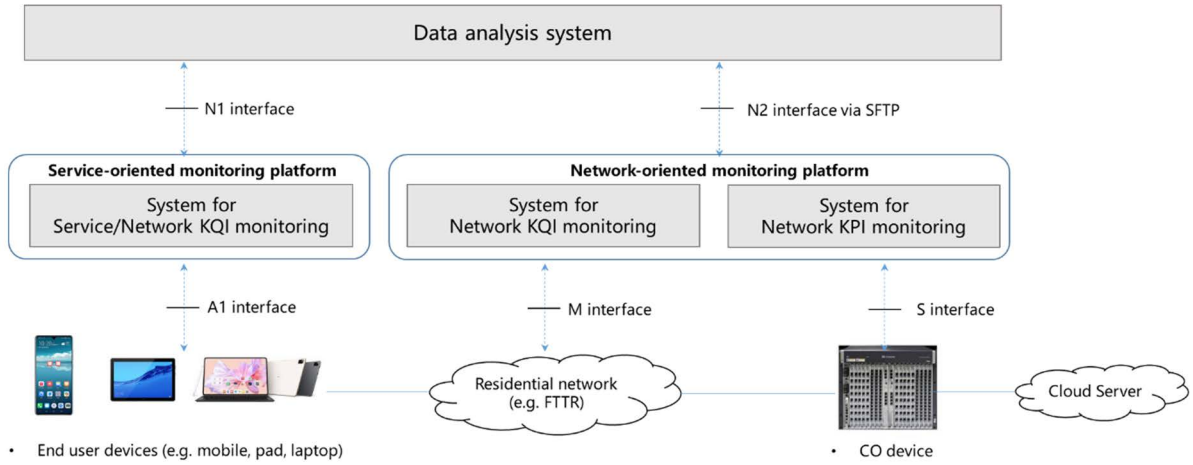


Figure 1: Functional architecture of the residential service quality monitoring

The user initiated monitoring function is performed by the interworking of the end user devices, the service-oriented monitoring platform and the data analysis system. It collects the service KQIs and subset of the network KQIs. The user initiated monitoring function communicates over the A1 interface between end user devices and the service-oriented monitoring platform and over the N1 interface between the service-oriented monitoring platform and the data analysis system (see Figure 1). The data collected from the end user devices is reported to the data analysis system.

The network KQI monitoring function is performed by the interworking of the residential network, the network-oriented monitoring platform and the data analysis system. It collects the network KQIs. The network KQI monitoring function communicates over the M interface between the residential network and the network-oriented monitoring platform and over the N2 interface between the network-oriented monitoring platform and the data analysis system (see Figure 1). The residential network collected data is reported to the data analysis system.

The network KPI monitoring function is performed by the interworking of the CO device, the network-oriented monitoring platform and the data analysis system. It collects the network KPIs. The network KPI monitoring function communicates over the S interface between the CO device and the network-oriented monitoring platform and over the N2 interface between the network-oriented monitoring platform and the data analysis system (see Figure 1). The CO device collected data is reported to data analysis system.

The present document only specifies the A1 and N2 interfaces. The N1 interface is vendor proprietary, defined by the service-oriented monitoring platform provider. The M interface is not specified in the present document and can leverage existing protocols (BBF TR-069 [3] or OMCI [4]). The S interface not specified in the present document and is for further study.

The network-oriented monitoring platform or the data analysis system can be part of network management system or a separate system. In the integration case, the network resources, the monitoring and the management can be performed through a common protocol stack.

The security of data exchange is protected through transport layer. The N2 interface shall use Security File Transfer Protocol (SFTP). TLS/SSL shall be used in A1 interface for data protection.

4.2 Monitoring the service/network KQIs by the service-oriented monitoring platform

4.2.1 Overview

The user initiated monitoring shown in Figure 2, it is mainly performed by the end user to obtain the service KQI and a subset of the network KQI. The data collected covers various network services, including web browsing, uploading/downloading, IPTV, online games, cloud games, online education/telework, cloud VR video, and cloud VR games [1]. The basic network KQIs includes throughput, latency, packet jitter, packet loss rate, and Wi-Fi® handover [1].

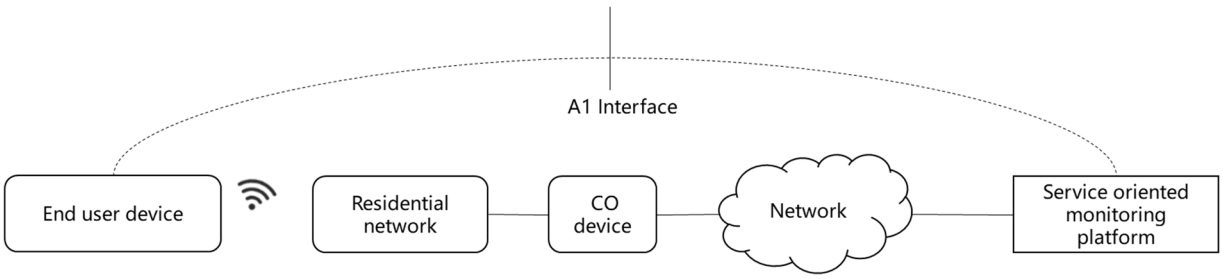


Figure 2: Monitoring of the service/network KQI through the service-oriented monitoring platform

4.2.2 Service-oriented monitoring functional model

Figure 3 shows the functional model of the service-oriented monitoring platform, including the interface module, the service KQI monitoring module, the network KQI monitoring module, and the basic info collection module.

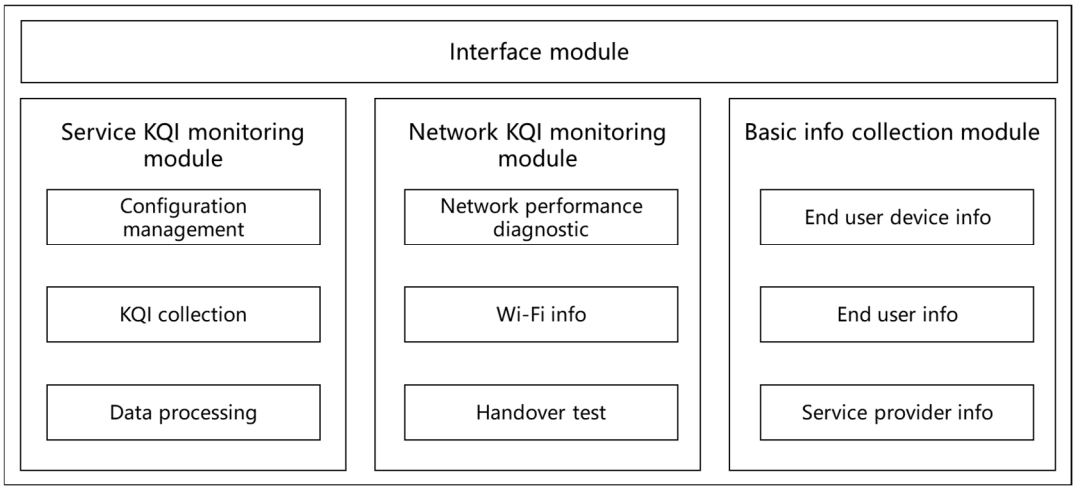


Figure 3: Functional model of service-oriented monitoring platform

The main function of the interface module is to encapsulate the message exchanged between the end user device and the service-oriented monitoring platform.

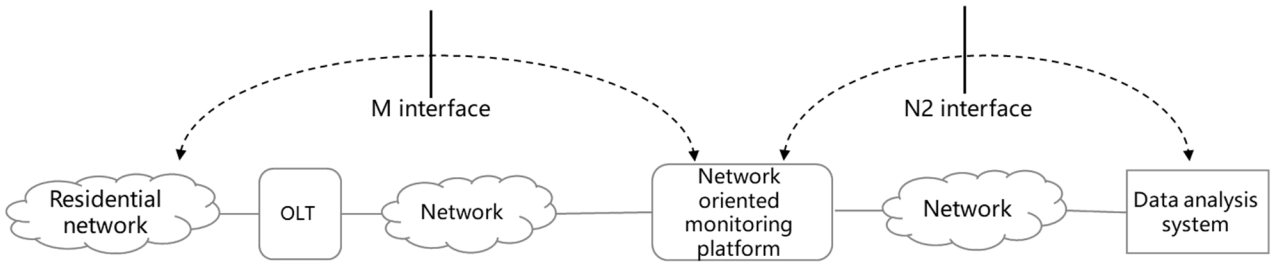
The service KQI monitoring module is part of the end user device, which collect the under-test network service information for the service-oriented monitoring platform. Such information contains the collected raw data for the network service KQI, the calculation of service KQI and the corresponding MOS values. The results are then uploaded to and stored in the service-oriented monitoring platform. The service-oriented monitoring platform completes the data processing. The end user can request the historical service KQI data and the corresponding ranking according to the MOS value compared with the other end users.

The network KQI monitoring module collects the network KQI, including the packet loss rate, the latency, the packet jitter, the Wi-Fi® handover data, and Wi-Fi® relevant information (refer to Table 7 in clause 5.4.2.6). All the data is uploaded to and stored in the service-oriented monitoring platform.

The basic info collection module collects the end user device software/hardware information, the basic end user information, and the service operator information. This data is uploaded to and stored in the service-oriented monitoring platform.

4.3 Monitoring the network KQIs by the network-oriented monitoring platform

The network KQI monitoring system (see Figure 1) collects the network KQIs for the network-oriented monitoring platform, generates the network performance data files, and transmit them to the data analysis system for management purposes. As shown in Figure 4, the network KQI monitoring function communicates over the M interface and the N2 interface (as described in clause 4.1). The network-oriented monitoring platform exports the network performance data files per collection cycle. The network performance data file is generated in the Comma Separated Values (CSV) format and the file is uploaded to the data analysis system.



NOTE: The application data flow is not shown in Figure 4.

Figure 4: Monitoring network KQI based on the network-oriented monitoring platform

5 Interface and data model for monitoring service KQIs

5.1 Overview

The end user initiates the monitoring which includes the collection of the service KQI and a subset of the network KQI, which corresponds to those in the current clause and clause 6.2 and clauses in ETSI GS F5G 017 [1].

5.2 A1 Interface

The A1 interface is a communication interface between the end user device and service-oriented monitoring platform.

The main functions of the A1 interface are as following:

1) Data reporting: including the basic user and network information, the end user device information, the service KQIs, and the network KQIs.

2) Data query: send query requests to the service-oriented monitoring platform to obtain test configuration and processing result.

5.3 Monitoring protocol

The software interface is encapsulated in JSON over HTTP/1.1, as shown in Figure 5.

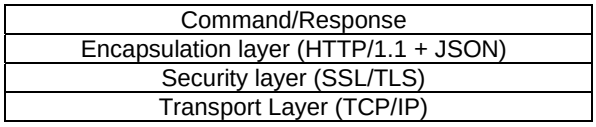


Figure 5: A1 interface stack

The format of the report request message sent over the interface is as follows:

```
POST /[path] HTTP/1.1
Accept: application/json
Content-Type: application/json; charset="utf-8"
Host: [host: port]
Content-Length: xxx
url: http://XX
[Report request parameters]
```

An example of a response message sent by the platform is as follows:

```
HTTP/1.1 200 OK
Content-Type: application/json; charset="utf-8"
Content-Length: xxx
{
    "code":
    "data": {
       Response parameters
    },
    "message":
}
```

SSL/TLS shall be used to negotiate a stateful connection by using a handshaking procedure, in which the client and server agree on various parameters used to establish the connection's security.

5.4 Data model

5.4.1 Overview of the monitoring methodologies

A monitoring message is defined as a JSON [12] array of data values. The monitoring messages are carried in the HTTP/1.1 payload. The monitoring messages between the end user devices and service-oriented monitoring platform are summarized in Table 1.

Table 1: Monitoring messages for A1 interface

Message type	Message name	Description
Message for query	GetWebList/GetSpeedserverInfo/GetIPTVList GetVideoList/GetVRVideoList	Request the measurement configuration of network services
	QueryMonthlyReport	Request the Monthly report of user's experience
Message for report	WebResult/SpeedResult/IPTVResult/ MobileGameResult/CloudGameResult/ VideoResult/e-LearningANDRemote officeResult/VRVideoResult/VRGameResult	Report of a dedicated service experience
	DiagnosisResult	Report the Network performance (delay, packet jitter, and packet loss)
	Wi-FiHandover	Report the Handover related information
	Wi-FiInfo	Report the Wi-Fi® related information
	CollectorInfo	Report the end user Information and the corresponding network
	TerminalInfo	Report the device software and hardware information
	TestResult	Report the comprehensive MOS value of a single measurement of the user experience

5.4.2 Data model design

5.4.2.1 Parameter type for data model

To correctly quantify transmit and receive data, the appropriate parameter types are defined in Table 2. The data messaging model is encoded by JSON, which is a standard text-based format for representing structured data based on JavaScript object syntax. All the message data are transformed to strings before being transmitted.

Table 2: Parameter type for data model

Parameter type	Definition
String	A String is a sequence of characters, either as a literal constant or as some kind of variable
Int32	Integer values can range from -2 147 483 648 (-231) to +2 147 483 647 (+231); it is represented as a string within this range
Float	Float values can range from -3,40E + 38 (-2128) ~ +3,40E + 38 (+2 128); it is represented as a string within this range
Double	Double values can range from -1,79E + 308 (-21 024) ~ +1,79E + 308 (+21 024); it is represented as a string within this range

NOTE: Table 2 is defined to achieve flexible and efficient usage of data expression for different parameters.

5.4.2.2 Measurement configuration request

Before measuring the end user experience, the end user device collects the measurement configuration from service-oriented monitoring platform. This is achieved by the end user device initiating a request to the service-oriented monitoring platform and waiting for an ACK. Table 3 summarizes the request message and corresponding parameters. For online gaming, cloud gaming, online education, and VR games, the end users should initiate the service.

Table 3: The minimum set of configuration request measurement parameters

Message name	Parameter name	Parameter type	Parameter Description
GetWebList	Name	String	Page Name
	index	Int32	Page ID, starting from 0
	url	String	Web page address
GetSpeedserverInfo	Name	String	Server name
	Index	Int32	Server ID
	Url	String	IP address of the speed test server
GetIPTVList	VODname	String	VOD name
	VODindex	Int32	VOD ID, starting from 0
	VODurl	String	VOD playback URL
	VODresolution	String	VOD Video Resolution
	BTVname	String	Live Video Name
	BTVindex	Int32	Live video ID
	BTVresolution	String	Live TV Resolution
GetVideoList	VideoSource	String	Video source type
	Name	String	Video name
	Index	Int32	Video ID, starting from 0
	Url	String	Video playback URL
	Resolution	String	Video resolution
GetVRVideoList	Name	String	Video name
	Index	Int32	Video ID, starting from 0
	Url	String	Video playback URL
	Resolution	String	Video resolution

5.4.2.3 Monthly report

The service-oriented monitoring platform collects the data for the service KQIs, periodically calculates the MOS values that reflect the user experience and calculates the ranking, which is a comparison of this user with the other residential users. The report is requested by the end user device and is responded to by the service-oriented monitoring platform. The corresponding data model is shown in Table 4.

Table 4: Parameters for monthly report

Message name	Parameter name	Parameter type	Parameter Description
QueryMonthlyReport	RequestMonth	String	Test time (year & month), in the format "yyyy-mm"
	TestCount	Int32	Number of test
	Web	Float	Average MOS of Web Page
	Speed	Float	Average MOS for upload/download
	IPTV	Float	Average MOS of live TV channel
	Mobilegame	Float	Average MOS of on-line Gaming
	Cloudgame	Float	Average MOS of cloud gaming
	Video	Float	Average MOS of VOD
	on-line education and telework	Float	Average MOS for on-line education/telework
	VR Video	Float	Average MOS of cloud VR video
	VR Game	Float	Average MOS of cloud VR game
	Region	String	The end user's region
	ExperienceAvg	Float	Average MOS of the region
	ExperienceRank	Int32	Ranking of the end user's region against all other regions in the past one month

5.4.2.4 Report of dedicated service KQIs

The end user device completes the service KQI measurement and sends the measurement results to the service-oriented monitoring platform. The corresponding data model is shown in Table 5.

Table 5: Parameters for reporting the service KQIs by the end user device to service-oriented monitoring platform

Message name	Parameter name	Parameter type	Parameter Description
WebResult	Weburl	String	Web page address
	PageResponseTime	Float	Page response time, in milliseconds
	FirstScreenDisplayTime	Float	First screen display time, in milliseconds
	FullLoadTime	Float	Full load time, in milliseconds
	WebMOS	Float	MOS value of web browsing
SpeedResult	SpeedCity	String	Server city for speed measurement
	SpeedOperator	String	Server owner (service provider)
	Speedurl	String	IP address of the speed measurement server
	RTTResult	Float	Round Trip Time in milliseconds.
	JitterResult	Float	Packet Jitter in milliseconds
	PacketLossResult	Float	Packet loss ratio represented in percentage (packets lost/total number of packets)
	UploadSpeed	Float	Upload rate, in Mbit/s
	DownloadSpeed	Float	Download rate, in Mbit/s
	UploadspeedRatio	Float	Upload rate ratio (actual data rate versus subscribed data rate)
	DownloadspeedRatio	Float	Download rate ratio (actual data rate versus subscribed data rate)
	SpeedMOS	Float	MOS of upload/download
IPTVResult	VODDownloadSpeedAvg	Float	Average download rate of VOD during the measurement
	VODdownloadTaffic	Float	VOD download traffic volume during the measurement, in MB.
	VODDownloadSpeedMax	Float	Peak download rate of VOD
	VODurl	String	VOD Video Source Address
	VODPlayTime	Float	VOD playback duration
	VODResolution	String	VOD Resolution
	VODInitialBufferTime	Float	Initial loading duration
	VODStallingRatio	Float	Freezing video duration ratio
	VODMOS	Float	MOS of VOD
	BTVDownloadSpeedAvg	Float	Average download rate of live TV
	BTVName	String	Name of live TV channel
	BTVResolution	String	Resolution of live TV
	ChannelSwitchTime	Float	Channel switching delay of live TV in seconds
	FrozenTimeRatio	Float	Blurred screen duration ratio
	FrozenScreenRatio	Float	Blurred screen area ratio
	BTVMOS	Float	MOS of live TV
MobileGameResult	GameName	String	Name of the on-line game
	AvgRTT	Float	Average round-trip time
	ServiceIp	String	Server IP address
	Time	List <String>	List of the timestamps, in the format of "hh:mm:ss"
	RTT	List <Float>	List of measured RTT according to the timestamp in milliseconds
	StartupTime	Float	Game start-up time
	GameStallingRatio	Float	Desynchronization time ratio
	ResponseTime	Float	Operation response delay
	MobileGameMOS	Float	MOS of terminal-based rendered gaming
CloudGameResult	GameName	String	Name of game
	ServiceIp	String	IP address of the server
	StallingtimeList	List <Float>	The list of freezing duration
	PlayTime	Float	Game duration measurement in ms
	GameStallingRatio	Float	Frame freezing time ratio
	ResponsetimeList	List <Float>	List of operation response delay
	CloudGameMOS	Float	MOS of cloud-based rendered gaming

Message name	Parameter name	Parameter type	Parameter Description
On-line education and telework Result	ServiceIp	String	Server IP address
	AvgRTT	Float	Average round-trip time
	RTT	List <Float>	List of round-trip time
	StallingtimeList	List <Float>	The list of freezing duration
	PlayTime	Float	Total measurement duration
	StallingRatio	Float	Frame freezing time ratio
	StallingNumber	Int32	Number of frame freezing
	InteractionDelay	Float	Interaction delay
	On-line education and teleworkMOS	Float	MOS of on-line education and telework
VRVideoResult	DownloadSpeedAvg	Float	Average download rate in the measurement duration
	DownloadSpeedMax	Float	Peak download rate
	VRVideourl	String	Cloud VR video source IP address
	VRvideoResolution	String	video Resolution
	VRVideoPlayTime	Float	Total measurement duration
	InitialBufferTime	Float	Initial buffering duration
	VRvideoStallingRatio	Float	Average percentage of frames freezing
	LowClearFrameRatio	List <Float>	List of low quality image area
	LowCleardurationRatio	List <Float>	List of low quality image duration
	VRVideoMOS	Float	MOS of cloud VR video
VRGameResult	VRGameName	String	Name of game
	ServiceIp	String	Server IP address
	BlakcScreenTimeRatio	Float	Percentage of the black edge duration
	BlakcScreenRatio	Float	Average percentage of the black edge area
	StallingtimeRatio	Float	Average percentage of frames freezing
	ResponseTime	Float	Operation response latency
	VRGameMOS	Float	MOS of cloud VR game

5.4.2.5 Network measurement report

The end user device can monitor network performance by connecting to a specific measurement server, the network performance includes the latency, packet jitter, packet loss rate and service type. The measurement report is sent by the end user device to the service-oriented monitoring platform. The corresponding data model is shown in Table 6.

Table 6: Parameters for network measurement report

Message name	Parameter name	Parameter type	Parameter Description
DiagnosisResult	E2EDelay	Double	E2E latency in millseconds
	E2EMaxDelay	Double	Maximum E2E latency
	E2EPacketLossRate	Double	E2E packet loss rate
	E2EJitter	Double	Maximum E2E packet jitter in milliseconds
	HomeDelay	Double	Latency of residential network
	HomeMaxDelay	Double	Maximum latency of residential network
	HomePacketLossRatio	Double	Packet loss ratio in the residential network represented in percentage (packets lost/total number of packets), received and calculated by the end user device
	HomeJitter	Double	Maximum packet jitter of residential network in millseconds
	ServiceType	String	Service type

5.4.2.6 Wi-Fi® related information report

The end user device periodically collects Wi-Fi® relevant information and sends it to the service-oriented monitoring platform. The corresponding data model is shown in Table 7.

Table 7: Parameters for Wi-Fi® related information report

Message name	Parameter name	Parameter type	Parameter Description
Wi-FiInfo	Name	String	Wi-Fi® name
	Dns	String	DNS name
	Ip	String	IP address
	Rssi	Int32	signal strength in dBm
	Freq	Int32	Frequency band
	SameFreq	Int32	Number of STA in collocated channels
	NeighborFreq	Int32	Number of STA in adjacent channels
	Capabilities	String	Encryption methodology type
	NegotiationSpeed	Int32	Data rate of air interface in Mbps
	Type	Int32	Protocol type: • Value 0 indicates unknown • Value 1 indicates IEEE 802.11a [5]/ 802.11b [6]/802.11g [7] • Value 4 indicates IEEE 802.11n [8] • Value 5 indicates IEEE 802.11ac [9] • Value 6 indicates IEEE 802.11ax [10] • Value 7 indicates IEEE P.802.11be [11]
	Channel	Int32	Channel number
	ChannelWidth	Int32	Channel bandwidth
	BssFac	String	Router vendor
	Mac	String	Router Mac address
	Bssid	String	Router BSSID

5.4.2.7 Handover related information report

After completion of the Wi-Fi® handover measurement, the end user device collects the Wi-Fi® handover process information. This report is sent by the end user device to the service-oriented monitoring platform. The corresponding data model is shown in Table 8.

Table 8: Parameters for Handover related information report

Message name	Parameter name	Parameter type	Parameter Description
Wi-FiHandover	SwitchTime	String	Timestamp when the switching occurred in the format of "hh:mm:ss"
	PacketlossRate	Float	Packet loss rate (see the test case as defined in clause 6.1.5 of ETSI GS F5G 017 [1])
	SwitchDuration	Float	Switching handover duration, in milliseconds
	BeforeBssid	String	BSSID before switching
	AfterBssid	String	BSSID after switching

5.4.2.8 User and network information report

The end user device reports basic residential network information to the service-oriented monitoring platform. The corresponding data model is shown in Table 9.

Table 9: Parameters for user & network information report

Message name	Parameter name	Parameter type	Parameter Description
CollectorInfo	Isp	String	Name of the service operator
	Bandwidth	String	Subscribed downlink rate (Mbit/s)
	Wi-FiName	String	SSID
	Interfacetype	Int32	Ways for the end user device to connect: 1: connected with Wi-Fi® 2: connected with Wired
	Country	String	Country
	Region	String	Region
	City	String	city
	Lat	String	Latitude in the resolution provided by the end user device
	Long	String	Longitude in the resolution provided by the end user device

5.4.2.9 Device information report

This message is used by the end user device to report basic software and hardware information to the service-oriented monitoring platform. The corresponding data model is shown in Table 10.

Table 10: Parameters for device information report

Message name	Parameter name	Parameter type	Parameter Description
TerminalInfo	Resolution	String	Resolution of end user device display
	SystemVersion	String	Operating System and version of the end user device
	Processor	String	CPU
	DevType	String	Model
	DevRom	String	ROM storage, in GB
	DevRam	String	RAM storage, in GB
	DevFirm	String	Vendor of the device

5.4.2.10 Service KQI measurement report

The end user device calculates the service KQI and corresponding MOS value after a single measurement. The measurement result is reported by the end user device to the service-oriented monitoring platform. The corresponding data model is shown in Table 11.

NOTE: The number provided in the parameter column below describes the index into the array, containing that particular measurement.

Table 11: Parameters for service KQI measurement report

Message name	Parameter name	Parameter type	Parameter Description
TestResult	AvgWeb	Float[]	Web browsing data statistics in a single measurement: 0: average page response time 1: average first screen display time 2: average full load time 3: average MOS 4: maximum MOS 5: minimum MOS
	AvgSpeed	Float[]	Upload/download data statistics in a single measurement: 0: average download rate ratio 1: average upload rate ratio 2: average MOS 3: average download speed (Mbit/s) 4: average upload speed (Mbit/s)

Message name	Parameter name	Parameter type	Parameter Description
TestResult	AvgIPTV	Float[]	IPTV data statistics in a single measurement: 0: average channel switching delay 1: average blurred screen duration ratio 2: average blurred screen area ratio 3: average MOS of live TV 4: minimum MOS of live TV 5: maximum MOS of live TV 6: average initial loading duration of VOD 7: average freezing video duration ratio of VOD 8: average MOS of VOD 9: minimum MOS of VOD 10: maximum MOS of VOD
	AvgMobileGame	Float[]	Terminal-based rendered gaming data statistics in a single measurement: 0: average network start-up time 1: average desynchronization time ratio 2: average operation response delay 3: average MOS
	AvgCloudGame	Float[]	Cloud-based rendered gaming data statistics in a single measurement: 0: average frame freezing time ratio 1: average operation response delay 2: average MOS
	AvgOn-Line education AND Telework	Float[]	Online Education/Telework data statistics in a single measurement: 0: average frame freezing times 1: average frame freezing time ratio 2: average interaction delay 3: average MOS
	AvgVRVideo	Float[]	Cloud VR video data statistics in a single measurement: 0: average initial buffering duration 1: average percentage of frames freezing 2: average percentage of low quality image area 3: average low quality image duration 4: average MOS 5: minimum MOS 6: maximum MOS
	AvgVRGame	Float[]	Cloud VR game data statistics in a single measurement: 0: average percentage of the black edge area 1: average percentage of the black edge duration 2: average percentage of frames freezing 3: average operation response delay 4: average MOS 5: minimum MOS 6: maximum MOS

5.5 Device capability

5.5.1 Capabilities of the service-oriented monitoring platform

The server capability of the service-oriented monitoring platform shall be determined based on the monitoring demand. The following is a reference list of service-oriented monitoring platform capability:

- Operating system: Windows or Linux based server.
- Number of CPU cores: ≥ 8.

- Operating memory: ≥ 16 GB.
- Storage for operating system: ≥ 80 GB.
- Storage for data: ≥ 200 GB.
- The Server should support secure functions to protect from virus and block external attack.
- It is required that there is a primary server and a backup server. When the primary server fails, the backup server becomes active to seamlessly provide the continuity of the service-oriented monitoring platform.
- The Server should provide secure data access and storage functions.

5.5.2 Requirements of end user device

The requirements of the end user device shall meet the requirements described in clause 5.1.1 of ETSI GS F5G 017 [1].

5.6 Management and maintenance

All monitoring tasks are initiated through a request from the end user device and responded to by the service-oriented monitoring platform. To protect the end user privacy and security, the service-oriented monitoring platform should not proactively initiate any tasks on the end user device.

6 Interface and data model for monitoring network KQIs

6.1 N2 Interface

The network performance data for the residential network and the network-oriented monitoring platform are transmitted to the data analysis system over the N2 interface.

6.2 Monitoring protocol

The protocol stack for the N2 interface is shown in Figure 6. SFTP [2] shall be used to exchange the network performance data between network-oriented monitoring platform and data analysis system.

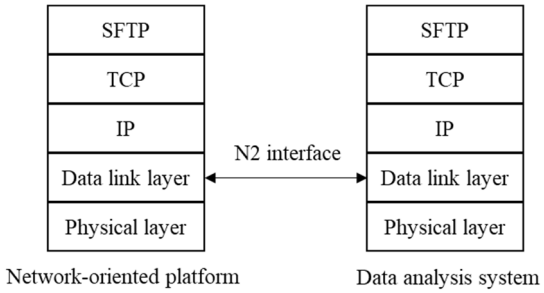


Figure 6: Protocol stack of N2 interface

The N2 interface supports a PUSH mode for file transmission in which the network-oriented system performs as an SFTP client, transmitting network performance data to the data analysis system designated as the SFTP server.

In SFTP, Security Shell protocol (SSH) is enabled, comprising three principal hierarchical components: the transport layer provides server authentication, confidentiality, and integrity. The user authentication protocol validates the user to the server; and the connection protocol multiplexes the encrypted tunnel into multiple logical communication channels.

6.3 Data model

The naming convention of the network performance data file shall be: < Resource type >-< Data version >-< Data time>-[Serial Number].< suffix >, shown in Table 12. A reference example is: *home-onu-pm-v1-202207050938460001.zip*.

Table 12: Naming convention of network performance data files

Composition	Description
Resource type	The resource types correspond to different data objects: • P-ONU performance evaluation: home-onu-pm. • E-ONU performance evaluation: home-ap-pm. • End user device (i.e. STA) performance evaluation: home-sta-pm.
Data version	The resource data version. EXAMPLE: "v1".
Data time	The starting generation time of resource data. The format shall be yyyymmddhhmmss. EXAMPLE: 20231101050938.
Serial number	The serial number is described in four digits. The valid value is from 0001 to 9999. When the resource data is quite large, the data shall be split into multiple segments. The segmentation shall follow these principles: • If the total resource data is less than 100 MB (±10 % is allowed as the threshold), only one data file shall be packed and transmitted. • If the total resource data is greater than 100 MB (±10 % is allowed as the threshold), the resource data file shall be split into multiple segment. Each part of the data segment (except the final segment) shall be between 90 MB and 110 MB. • In the data splitting process, an incomplete record cannot be split into two segments. The number of segments shall follow the ascending order from 0001 to 9999.
suffix	File type. The resource data files shall be compressed by zip and the suffix is "zip".

Network performance data files are all CSV type files. Every line in the data file is an independent and complete. For parameters without a value, the default is NULL. Each CSV file is compressed and saved as a zip file.

For different residential network devices, the performance evaluation data model are shown in Table 13 to Table 15. Table 13 shows the performance evaluation of the P-ONU.

Table 13: P-ONU performance evaluation data model

Parameter	Type	Description	Example
Gateway MAC Address	String	The MAC address of the P-ONU.	28A6DBE647B6
Time Stamp	Int32	Timestamp of data generation. Format: UTC time. Unit: ms.	1589240000000
Subscribed Bandwidth	Int32	The bandwidth subscribed by the end user. Unit: Mbps	1 000
Average Tx Rate	Float	Average transmission rate of P-ONU upstream. Unit: Mbps.	123,43
Average Rx Rate	Float	Average receive rate of P-ONU downstream. Unit: Mbps.	123,43
Ping Delay	Int32	PING delay of the connected device (E-ONU +End user device). Unit: ms.	12
Ping Jitter	Int32	PING delay jitter of the connected device (E-ONU + End user device). Unit: ms.	2
Uplink PLR	Int32	Upstream packet loss rate of the connected device (E-ONU + End user device. Unit: %. Valid value: 0-100.	1
Downlink PLR	Int32	Downstream packet loss rate of connected device (E-ONU + End user device). Unit: %. Valid value: 0-100.	1
Handover Latency	Int32	End user device (i.e. STA) handover delay. Unit: ms.	100
Average 2,4 GHz RSSI	Int32	Signal strength of 2,4 GHz band. Unit: dBm.	-60
Average 5 GHz RSSI	Int32	Signal strength of 5 GHz band. Unit: dBm.	-65

Parameter	Type	Description	Example
Average 2,4 GHz Interference Duty Cycle	Int32	2,4 GHz band interference duty cycle. Unit: %. Valid value: 0~100.	64
Average 5 GHz Interference Duty Cycle	Int32	5 GHz band interference duty cycle. Unit: %. Valid value: 0~100.	64
Average 2, 4G Idle Duty Cycle	Int32	2,4 GHz band idle duty cycle. Unit: %. Valid value range: 0~100	64
Average 5 GHz Idle Duty Cycle	Int32	5 GHz band idle duty cycle. Unit: %. Valid value range: 0~100.	64
Average 2,4 GHz Noise	Int32	2,4 GHz band noise level. Unit: dBm.	-64
Average 5 GHz Noise	Int32	5 GHz band noise level. Unit: dBm.	-64
2,4 G Channel	Int32	2,4 GHz Channel number.	2
5 GHz Channel	Int32	5 GHz Channel number.	36
Number of Concurrent Active AP Devices	Int32	Number of concurrent online E-ONU devices.	2
Number of Concurrent Active 2,4 GHz Wi-Fi® Devices	Int32	Number of concurrent online 2,4 GHz Wi-Fi® Devices in P-ONU.	3
Number of Concurrent Active 5 GHz Wi-Fi® Devices	Int32	Number of concurrent online 5 GHz Wi-Fi® Devices connected directly to the P-ONU.	4

Table 14: E-ONU performance evaluation data model

Parameter	Type	Description	Example
AP MAC Address	String	The MAC address of the E-ONU.	E03DB236EM80
Time Stamp	Int32	Timestamp of data generation. Format: UTC time. Unit: ms.	1589240000000
Gateway MAC Address	String	The MAC address of the P-ONU.	28A6DBE647B6
Parent AP MAC Address	String	The MAC address of the uplink AP, if the uplink device is P-ONU, this field is null.	203DB236E578
Access Mode	String	The access mode in which the E-ONU is connected to the uplink device. Valid values: • Ethernet uplink. • Wi-Fi® 2,4 GHz uplink. • Wi-Fi® 5 GHz uplink. • G.fin: 2,5 Gbps. • Empty: Not recognized.	Ethernet
Average 2,4 GHz RSSI	Int32	Signal strength of 2,4 GHz band. Unit: dBm.	-60
Average 5 GHz RSSI	Int32	Signal strength of 5 GHz band. Unit: dBm.	-65
Average 2,4 GHz Interference Duty Cycle	Int32	2,4 GHz band interference duty cycle. Unit: %. Valid value: 0~100.	64
Average 5 GHz Interference Duty Cycle	Int32	5 GHz band interference duty cycle. Unit: %. Valid value: 0~100.	64
Average 2,4 GHz Idle Duty Cycle	Int32	2,4 GHz band idle duty cycle. Unit: %. Valid value range: 0~100.	64
Average 5 GHz Idle Duty Cycle	Int32	5 GHz band idle duty cycle. Unit: %. Valid value range: 0~100.	64
Average 2,4 GHz Noise	Int32	2,4 GHz band noise level. Unit: dBm.	-64
Average 5 GHz Noise	Int32	5 GHz band noise level. Unit: dBm.	-64
2,4 GHz Channel	Int32	2,4 GHz Channel.	2
5 GHz Channel	Int32	5 GHz Channel.	36
Average Uplink Rate	Float	Average throughput of E-ONU upstream. Unit: Mbps.	23,5
Average Downlink Rate	Float	Average throughput of E-ONU downstream. Unit: Mbps.	23,5
Average 2,4 GHz Wi-Fi® Negotiated Rx Rate	Float	2,4 GHz uplink negotiated reception rate. Unit: Mbps.	23,5
Average 2,4 GHz Wi-Fi® Negotiated Tx Rate	Float	2,4 GHz uplink negotiated send rate. Unit: Mbps.	23,5
Average 5 GHz Wi-Fi® Negotiated Rx Rate	Float	5 GHz uplink negotiated reception rate. Unit: Mbps.	23,5

Parameter	Type	Description	Example
Average 5 GHz Wi-Fi® Negotiated Tx Rate	Float	5 GHz uplink negotiated send rate. Unit: Mbps.	23,5
Maximum Uplink Rate	Float	The maximum uplink rate from the E-ONU to the uplink P-ONU/AP. Unit: Mbps.	100,98
Maximum Downlink Rate	Float	The maximum downlink rate from the E-ONU to the uplink P-ONU/AP. Unit: Mbps.	100,98
Number of Concurrent Active 2,4 GHz Wi-Fi® Devices	Int32	Number of concurrent online 2,4 GHz Wi-Fi® Devices	3
Number of Concurrent Active 5 GHz Wi-Fi® Devices	Int32	Number of concurrent online 5 GHz Wi-Fi® Devices	4

Table 15: End user device performance evaluation Data model

Parameter	Type	Description	Example
STA MAC Address	String	The MAC address of the End user device.	203DB236E571
Time Stamp	Int32	Timestamp of data generation. Format: UTC time. Unit: ms.	15892400000
Gateway MAC Address	String	The MAC address of the P-ONU.	28A6DBE647B6
AP MAC Address	String	The MAC address of the E-ONU.	E03DB236EM80
Access Mode	String	The access mode in which the End user device is connected to the uplink device. Valid values: • Ethernet uplink; • 2,4 GHz: 2,4 GHz uplink; • 5 GHz: 5 GHz uplink; • Empty: Not recognized.	LAN
Average Uplink Rate	Float	The average uplink rate from the End user device to the uplink device. Unit: Mbps.	23,5
Average Downlink Rate	Float	The average downlink rate from the uplink device to the End user device. Unit: Mbps.	23,5
Average 2,4 GHz Wi-Fi® Negotiated Rx Rate	Float	2,4 GHz uplink negotiated reception rate. Unit: Mbps.	23,5
Average 2,4 GHz Wi-Fi® Negotiated Tx Rate	Float	2,4 G uplink negotiated send rate. Unit: Mbps	23,5
Average 5 GHz Wi-Fi® Negotiated Rx Rate	Float	5 GHz uplink negotiated reception rate. Unit: Mbps.	23,5
Average 5 GHz Wi-Fi® Negotiated Tx Rate	Float	5 GHz uplink negotiated send rate. Unit Mbps.	23,5
Maximum Uplink Rate	Float	The maximum uplink rate from the End user device to the uplink device. Unit: Mbps.	100,98
Maximum Downlink Rate	Float	The maximum downlink rate from the uplink device the to End user device. Unit: Mbps.	100,98
Ping Delay	Int32	PING delay of the End user device. Unit: ms.	12
Ping Jitter	Int32	PING delay jitter of the End user device. Unit: ms.	2
Uplink PLR	Int32	Upstream packet loss rate of the End user device. Unit: %. Valid value: 0-100.	1
Downlink PLR	Int32	Downstream packet loss rate of the End user device. Unit: %. Valid value: 0-100.	5

6.4 Data collection cycle requirements

The collection period shall be configurable, and the default minimum period shall be 5 min.

6.5 Management and maintenance

The network-oriented monitoring platform shall support the management and regular data cleansing of network performance data files.

History

Document history		
V1.1.1	August 2024	Publication