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SERIES Y: GLOBAL INFORMATION INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS, NEXT-GENERATION NETWORKS, INTERNET OF THINGS AND SMART CITIES

Big Data

Big data driven networking – requirements

Recommendation ITU-T Y.3652

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ITU-T Y-SERIES RECOMMENDATIONS

GLOBAL INFORMATION INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS, NEXT-GENERATION NETWORKS, INTERNET OF THINGS AND SMART CITIES

GLOBAL INFORMATION INFRASTRUCTURE	
General	Y.100–Y.199
Services, applications and middleware	Y.200–Y.299
Network aspects	Y.300–Y.399
Interfaces and protocols	Y.400–Y.499
Numbering, addressing and naming	Y.500–Y.599
Operation, administration and maintenance	Y.600–Y.699
Security	Y.700–Y.799
Performances	Y.800–Y.899
INTERNET PROTOCOL ASPECTS	
General	Y.1000–Y.1099
Services and applications	Y.1100–Y.1199
Architecture, access, network capabilities and resource management	Y.1200–Y.1299
Transport	Y.1300–Y.1399
Interworking	Y.1400–Y.1499
Quality of service and network performance	Y.1500–Y.1599
Signalling	Y.1600–Y.1699
Operation, administration and maintenance	Y.1700–Y.1799
Charging	Y.1800–Y.1899
IPTV over NGN	Y.1900–Y.1999
NEXT GENERATION NETWORKS	
Frameworks and functional architecture models	Y.2000–Y.2099
Quality of Service and performance	Y.2100–Y.2199
Service aspects: Service capabilities and service architecture	Y.2200–Y.2249
Service aspects: Interoperability of services and networks in NGN	Y.2250–Y.2299
Enhancements to NGN	Y.2300–Y.2399
Network management	Y.2400–Y.2499
Network control architectures and protocols	Y.2500–Y.2599
Packet-based Networks	Y.2600–Y.2699
Security	Y.2700–Y.2799
Generalized mobility	Y.2800–Y.2899
Carrier grade open environment	Y.2900–Y.2999
FUTURE NETWORKS	Y.3000–Y.3499
CLOUD COMPUTING	Y.3500–Y.3599
BIG DATA	**Y.3600–Y.3799**
QUANTUM KEY DISTRIBUTION NETWORKS	Y.3800–Y.3999
INTERNET OF THINGS AND SMART CITIES AND COMMUNITIES	
General	Y.4000–Y.4049
Definitions and terminologies	Y.4050–Y.4099
Requirements and use cases	Y.4100–Y.4249
Infrastructure, connectivity and networks	Y.4250–Y.4399
Frameworks, architectures and protocols	Y.4400–Y.4549
Services, applications, computation and data processing	Y.4550–Y.4699
Management, control and performance	Y.4700–Y.4799
Identification and security	Y.4800–Y.4899
Evaluation and assessment	Y.4900–Y.4999

For further details, please refer to the list of ITU-T Recommendations.

Recommendation ITU-T Y.3652

Big data driven networking – requirements

Summary

Big data driven networking (bDDN) is a group of technologies and methods to facilitate network operation, administration, maintenance and optimization, etc. based on the big data generated by the network and a series of methods and tools. That is to say, big data generated by the network are used to serve the network and make the network better.

Recommendation ITU-T Y.3652 specifies requirements of big data driven networking. This Recommendation studies general requirements for big data driven networking, requirements of big data plane for big data driven networking, requirements of network plane for big data driven networking, requirements of management plane for big data driven networking and interface requirements for big data driven networking.

History

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FOREWORD

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Table of Contents

Recommendation ITU-T Y.3652

Big data driven networking – requirements

1 Scope

This Recommendation specifies requirements of big data driven networking.

The scope of this Recommendation includes:

– general requirements for big data driven networking;
– requirements of big data plane for big data driven networking;
– requirements of network plane for big data driven networking;
– requirements of management plane for big data driven networking;
– interface requirements for big data driven networking;
– security aspect requirements for big data driven networking.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T X.200] Recommendation ITU-T X.200 (1994) | ISO/IEC 7498-1:1994, *Information technology. Open Systems Interconnection. Basic Reference Model: The basic model*.

[ITU-T X.731] Recommendation ITU-T X.731 (1992) | ISO/IEC 10164-2:1993, *Information technology – Open Systems Interconnection – Systems management: State management function*.

[ITU-T Y.1221] Recommendation ITU-T Y.1221 (2010), *Traffic control and congestion control in IP-based networks*.

[ITU-T Y.2704] Recommendation ITU-T Y.2704 (2010), *Security mechanisms and procedures for NGN*.

[ITU-T Y.2770] Recommendation ITU-T Y.2770 (2012), *Requirements of deep packet inspection in next generation networks*.

[ITU-T Y.2771] Recommendation ITU-T Y.2771 (2014), *Framework for deep packet inspection*.

[ITU-T Y.3650] Recommendation ITU-T Y.3650 (2018), *Framework of big-data-driven networking*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following term defined elsewhere:

3.1.1 big data driven networking (bDDN) [ITU-T Y.3650]: A type of future network framework that collects big data from networks and applications, and generates big data intelligence based on the big data; it then provides big data intelligence to facilitate smarter and autonomous network management, operation, control, optimization and security, etc.

3.2 Terms defined in this Recommendation

This Recommendation defines the following term:

3.2.1 API gateway: A server that is the single-entry point into the system.

NOTE – The application programming interface (API) gateway encapsulates the internal system architecture and provides an API that is tailored to each client. An API gateway takes all API calls from clients, then routes them to the appropriate micro-service with request routing, composition, and protocol translation. Typically it handles a request by invoking multiple micro services and aggregating the results, to determine the best path. It can translate between web protocols and web-unfriendly protocols that are used internally.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

API	Application Programming Interface
BSS	Business Support System
bDDN	Big Data Driven Networking
CLI	Command Line Interface
DB	Database
DDI	Domain-Domain Interface
DPI	Deep Packet Inspection
EMS	Element Management System
ETL	Extract-Transform-Load
FS	File System
FTP	File Transfer Protocol
GIS	Geographic Information System
HTTP	Hyper-Text Transfer Protocol
IP	Internet Protocol
IPC	Inter-Process Communication
NFV	Network Function Virtualization
NMS	Network Management System
NoSQL	No SQL or Not only SQL
OAM	Operation Administration Maintenance
OSS	Operation Support System
QoE	Quality of Experience
QoS	Quality of Service
REST	Representational State Transfer
SDN	Software Defined Network

SNMP Simple Network Management Protocol

SQL Structured Query Language

YANG Yet Another Next Generation

5 Conventions

The keywords "**is required to**" indicate a requirement which must be strictly followed and from which no deviation is permitted, if conformance to this Recommendation is to be claimed.

The keywords "**is recommended to**" indicate a requirement which is recommended but which is not absolutely required. Thus, this requirement need not be present to claim conformance.

In the body of this Recommendation and its annexes, the words shall, shall not, should, and may sometimes appear, in which case they are to be interpreted, respectively, as is required to, is prohibited from, is recommended, and can optionally. The appearance of such phrases or keywords in an appendix or in material explicitly marked as informative are to be interpreted as having no normative intent.

6 General requirements for big data driven networking

6.1 General functional requirements

As described in [ITU-T Y.3650], big data driven networking (bDDN) is a type of future network architecture, that provides functions and capabilities based on big data to facilitate network planning, management, operation, control, optimization and security, etc.

The capabilities of bDDN, including capabilities of big data plane, network plane, management plane and interfaces capabilities are described in [ITU-T Y.3650]. In order to support all these capabilities, the general functional requirements of bDDN are described as follows:

– bDDN is required to support big data collection capabilities, the aforementioned big data including structured data, non-structured data and semi-structured data;

– bDDN is recommended to support big data pre-processing capabilities, the aforementioned big data including structured data, non-structured data and semi-structured data;

– bDDN is required to have no influence on the performance of the network infrastructure when bDDN system is collecting data from the network;

– bDDN is recommended to have the capabilities for classifying the big data during the process of data collection;

– bDDN is required to support big data storage capabilities, the aforementioned big data including structured data, non-structured data and semi-structured data;

– bDDN is required to support big data analysing capabilities, the aforementioned big data including structured data, non-structured data and semi-structured data;

– bDDN is required to provide data mining functions and services for their upper layer applications;

NOTE 1 – 'Upper layer applications' means applications that can make use of functions and capabilities provided by bDDN.

– bDDN is required to support self-service capabilities for bDDN users;

NOTE 2 – 'Self-service capabilities' means functions and capabilities to provide service to the network itself.

– bDDN is required to provide prediction of network behaviour functions;

– bDDN is required to support service interface capabilities for network planning;

– bDDN is recommended to support softwarization capabilities for network planning;

– bDDN is required to support programmability for applications based on bDDN to the network resources;

– bDDN is required to support big data driven network management capabilities: operation, administration and maintenance;

NOTE 3 – 'Big data driven' means a process or activity which is engaged and improved by big data related technologies. For example, big data driven network management means network management activity which is enabled by big data related technologies.

– bDDN is required to support big data driven network control and orchestration capabilities;

– bDDN is required to support big data driven network planning and optimization capabilities;

– bDDN is required to support big data driven network security guaranteeing capabilities;

– bDDN is required to provide interfaces between planes, including interfaces between big data plane and network plane, interfaces between big data plane and management plane;

– bDDN is required to provide interfaces between layers within the planes of big data driven networking, including interfaces between layers of big data plane, interfaces between layers of network plane;

– bDDN is required to support interfaces between related control domains;

– bDDN is recommended to support network slicing capabilities for the target network;

– bDDN is required to guarantee that activities of big data plane do not worsen the performance for network plane.

6.2 General performance requirements

– bDDN is recommended to collect all data from the network in real time mode.

– bDDN is required to store various data generated by the network without loss.

– bDDN is required to store full historical data according to configuration from the bDDN application.

– bDDN is recommended to analyse data in real time mode.

– bDDN is required to have process capability matching to real-time data volume when it works in real time mode.

– bDDN is required to finish analysing data within the time given by a certain bDDN application.

– bDDN is required to finish analysing data within a time threshold set by bDDN itself when the time is not given by a certain bDDN application. For example, a time threshold is 50s since the data are input to bDDN.

NOTE – Except for special notation, the aforementioned data in clause 6.2 include but are not limited to data generated by deep packet inspection (DPI), logs, alarms, management, data related to network environment and so on.

All data collection should be under permission and authorization of corresponding privacy policy and rules.

7 Requirements of big data plane for bDDN

7.1 Requirements of network big data collection for bDDN

7.1.1 Data source of big data collection

– bDDN is required to collect the data from several kinds of networks, including mobile networks and fixed networks, and including Internet, enterprise networks, home networks and so on.

– bDDN is required to collect the data from various network elements, including routers, switches, base stations, mobile terminals, gateways and so on.

– bDDN is required to collect the data from various management entities, including element management system / network management system (EMS/NMS) entities, business support system / operation support system (BSS/OSS) entities and so on.

– bDDN is required to collect the data from various bDDN applications, e.g., a kind of traffic analysing software which depends on bDDN.

NOTE – bDDN applications are entities that use functions provided by bDDN. For example, an operation support system, a network management system, etc.

– bDDN is required to collect the various data related to the network, the various data include service data, signal data, and some management related data such as device information, configuration data, routing data, environmental data, etc.

7.1.2 Data scope of big data collection

It is noted that it is not all the data but rather it is the key data that is to be collected. The key data is useful for analysing and making decisions and can be classified in the following categories:

– Control information related to regular short-term network operations, covering functionalities such as call/session set-up, release and maintenance, security, QoS, idle and connected mode mobility, and radio resource control, etc.

– Management information covering long-term network operation functionalities, such as fault, configuration, accounting, performance and security management, as well as customer and terminal management. An example of such information is that defined for operation and management, which consists of aggregated statistics on network performance, such as number of active users, active bearers, successful/failed handover events, etc., per base station, as well as information gathered by means of active probing.

  – bDDN is required to support collection of network management data;

  – bDDN is required to support network operation support system (OSS) data collecting;

  – bDDN is required to support network business support system (BSS) data collecting;

  – bDDN is required to support network system log data collecting;

  – bDDN system is required to collect the various data related to network users, including basic information of network users, user quality of service (QoS) requirement and user quality of experience (QoE) status, etc.

7.1.3 Type of big data collection

– bDDN is required to collect multi-type data, which includes structured data, unstructured data and semi-structured data;

– bDDN is required to support multi-source heterogeneous data collecting;

– bDDN is required to collect the log data;

– bDDN is required to collect the configuration data of the network;

– bDDN is required to collect the alarm/warning data;

– bDDN is required to collect the device state data;

– bDDN is recommended to collect the environment data of the network;

– bDDN is recommended to collect some traffic data according to the requirements of the application;

– bDDN is recommended to collect all the other data about the network device;

NOTE – The other data about the network device are data other than log data, configuration data, alarm/warning data, device state data and environment data. For example, device name, device manufacturer identification, device location, etc.

7.1.4 Methods of big data collection

– bDDN is required to support multiple methods for big data collection.

NOTE – For example, bDDN can use deep packet inspection to collect traffic data meanwhile, and bDDN can collect network management data from the network management system (NMS).

– bDDN is required to support collecting big data scattered in various interfaces of the network using DPI technology.

– bDDN is required to support gathering records, log files, signal streams from network management devices.

– bDDN is required to support obtaining external data from external systems or getting it from the Internet.

– bDDN is required to support network traffic data sensing based on DPI.

– bDDN is recommended to support the following collection data interfaces: simple network management protocol (SNMP), file transfer protocol (FTP), hyper-text transfer protocol (HTTP), RESTful service and so on.

– bDDN is recommended to support configuration of collection mode, including active sensing mode and passive sensing mode.

– bDDN is required to support active sensing (push mode) big data collection methods.

SNMP-based network monitoring is long overdue for an upgrade. It was designed for legacy implementations, with poor scaling for today's high-density platforms, and very limited extensibility. Push mode is an approach for network monitoring in which data is streamed from devices continuously with efficient, incremental updates. Operators can subscribe to the specific data items they need, using yet another next generation (YANG) data models as the common structure and interface.

A push mode continuously streams data out of the network and notifies the client. bDDN enables the push model, which provides near-real-time access to monitoring data.

– bDDN is recommended to support use of YANG models to collect data in push mode.

– bDDN is required to support passive sensing (pull mode) collection big data methods.

Traditional collection methods use the pull mode when retrieving data from a network device, such as SNMP, command line interface (CLI), and Syslog, used for collecting operational statistics from a network. The pull model is based on a client sending a request to the device, then the device responds to that request. This method has several restrictions due to the growth of objects such as Internet of things (IoT) devices and cloud-based applications.

This model cannot scale for high-density devices, and offers very limited extensibility. On average, network operators use SNMP poll data every five to thirty minutes, but with today's speeds and scale that is not enough to capture important network events. SNMP also uses a push model while sending a trap.

Active sensing is a method where the collection object automatically sends the big data to the big data plane and passive mode is a method where the big data plane acquires the data from the

collection object. The collection objects should be configurable and the collection interval, frequency, data format, etc. should be configurable.

The active sensing method is recommended to support the following features:

In-network customization: The data can be customized in network at run-time to meet to the specific need of applications. This needs the support of a programmable network plane which allows probes to be deployed at flexible locations.

Direct data plane export: The data originated from network plane can be directly exported to the data consumer for efficiency, especially when the data bandwidth is large and the real-time processing is required.

In-band data collection: the active sensing approach allows data to be collected directly for any target flow on its entire forwarding path.

Non-intrusive: the active sensing method should not change the network behaviour or affect the forwarding performance.

7.2 Requirements of network big data repository

7.2.1 Requirements of big data pre-processing

– bDDN is required to do some data pre-processing according to several pre-set rules, simultaneously when data is collected;

– bDDN is recommended to support extract-transform-load (ETL) features of big data;

– It is recommended for the ETL function to be achieved through the distributed computing nodes and to be able to dynamically expand according to the computing load.

– bDDN is recommended to support data aggregation functions of big data;

– bDDN is recommended to support data cleaning and transformation functions for heterogeneous structured data;

– bDDN is recommended to support normalizing the network big data for analysing.

7.2.2 Requirements of big data storage

– bDDN is required to support the storage of structured data;

– bDDN is required to support the storage of unstructured data;

– bDDN is recommended to support for distributed and scalable storage architecture;

– bDDN is required to support the configurable storage duration according to the requirements.

– bDDN is required to provide multiple types of database to store big data of different types and origin, the aforementioned databases include but are not be limited to the following:

  • Relational database;

  • No SQL or not only SQL (NoSQL) database;

  • File system;

  • Distributed file system.

7.3 Requirements of network big data analysing

– bDDN is required to provide big data processing and analysing capabilities;

– bDDN is required to support multi-source heterogeneous data analysing, the aforementioned data to include but not be limited to the following:

  • IPv4/IPv6 network data;

  • Fixed/mobile network data;

- Access/converge/core network data;
- Text/audio/video data;
- Traffic/BSS/OSS data;
- System log data.

7.3.1 big data analysis method

– bDDN is required to support multiple analysis methods, the aforementioned methods to include but not be limited to the following:
  - Statistical analytical method
  - Visualization analytical method
  - Correlation analytical method
  - Prediction analytical method
  - Analytical method based on machine learning

7.3.2 big data analysis platform

– bDDN is recommended to support multiple types of big data analysis platforms, the aforementioned platforms to include but not be limited to the following:
  - Real-time analysis platform
  - Batch processing
  - Machine learning

– bDDN is recommended to use a distributed analytical platform and parallel processing capabilities;

7.4 Requirements of network big data service

Concerning network big data service, there are some requirements that are listed as follows:

– bDDN is required to support open softwarization service interface for other entities, the aforementioned interfaces to include but not be limited to the following:
  - API: application program interface;
  - IPC: inter-process communication;
  - RESTful: representational state transfer.

– bDDN is required to support a visualization service for network planners, operators;

– bDDN is required to support network big data exchanging service for other entities;

7.4.1 Big data visualization

The results from big data mining, analysing and real-time computing are recommended to be illustrated in visual representations, so as to help network operators to gain the meaning of big data directly.

– bDDN is required to support the accessing and importing of structured data, semi-structured data and non-structured data.

– bDDN is required to support the accessing and importing of data in multi-type databases or multiple data formats.

– bDDN is required to support the accessing and importing of data through API.

– bDDN is recommended to support various charts, tables and images, including but not limited to: histogram, curve diagram, scatter diagram, waterfall diagram, Sankey diagram, geographic information system (GIS) map, etc.

– bDDN is recommended to support the visualization in multiple modes.

NOTE – Examples of visualization modes include web browsers, application terminals, GUI software, etc.

7.4.2 End to end network intelligence

Based on the big data which is collected and analysed, there are some requirements to support end to end network intelligence through corresponding analysis and prediction models or methods, including network operation, network administration and network maintenance. The aforementioned requirements include the following:

– bDDN is recommended to support the function of the request management, such as the queue of requests, the priority of the request; the authentication of requests;

– bDDN is recommended to support the functions of access control, security authentication, authorization management;

– bDDN is recommended to support a service management function; service refers to the capability provided by the big data plane; service management includes the management and configuration of the service interface (e.g., service HTTP, web);

– bDDN is recommended to support the function of load balancing, and resource scheduling according the service load.

– Big data plane is recommended to provide various self-services for the network plane and management plane, the services it is recommended to provide include but are not be limited to the following:

  • The self-optimization service for the network infrastructure layer of the network plane;
  • The self-optimization service for the network controller of the network plane;
  • The self-optimization service for the application layer of the network plane;
  • The self-optimization service for network maintenance of the management plane;
  • The self-optimization service for network administration of the management plane;
  • The self-optimization service for network operation and marketing of the management plane.

7.4.3 Network QoS anomaly detection and root cause tracking

Different applications have different QoS parameter requirements, for example, delay/latency, jitter, round trip time, etc. Network QoS anomaly means a network QoS parameters anomaly. To meet the complex QoS/QoE requirements of different applications/services, the requirements of the bDDN are as follows:

– bDDN is recommended to support automatic monitoring and detecting of the network QoS anomalies.

– bDDN is recommended to support tracking the root causes of the network QoS anomalies.

7.4.4 Using an API gateway to provide service

bDDN is recommended to use an API gateway to provide the service for an application. An API gateway is a server that is the single-entry point into the system. The API gateway encapsulates the internal system architecture and provides an API that is tailored to each client. An API gateway takes all API calls from clients, then routes them to the appropriate micro service with request routing, composition, and protocol translation. Typically, it handles a request by invoking multiple micro services and aggregating the results, to determine the best path. It can translate between web protocols and web-unfriendly protocols that are used internally. It might have other responsibilities such as authentication, monitoring, load balancing, caching, request shaping and management, and static response handling.

– bDDN is recommended to use an API gateway to provide the service for application.

– bDDN is recommended to use an API gateway to provide the authentication capability of the service.
– bDDN is recommended to use an API gateway to provide the monitoring capability of the service.
– bDDN is recommended to use an API gateway to provide the load balancing capability of the service.
– bDDN is recommended to use an API gateway to provide the management capability for the service.

8 Requirements of network plane for big data driven networking

8.1 Requirements of network application layer

The network programmability ensures that the network application has the capability to dynamically control and orchestrate the network resource through a network controller. The big data intelligence and service layer provide the network applications with the ability and method to control and orchestrate the network resources.

On the other hand, as the bridge between network plane and management plane, the network application layer implements functions to provide information to the management plane and accept instructions from the management plane.

The requirements of the network application layer of bDDN include the following aspects:

– Network application layer is required to have the capability to get big data intelligence and service from the big data plane to guide the controlling and orchestrating of the network resource.

  NOTE – Big data intelligence in this Recommendation is the capability or functions that a big data plane of bDDN can provide through analysis of the big data.
– Network application layer is required to have the capability to set up rules or policies for big data plane in order that big data plane can provide big data intelligence and service that are necessary for the network application layer.
– Network application layer is required to have the capability to control and orchestrate the network resources through the network controller.
– Network application layer is required to have the capability to provide management information that need not be processed by big data plane to management plane.
– Network application layer is required to have the capability to accept management instructions from the management plane and transform the instructions to the network control layer.

8.2 Requirements of network control layer

The network controller layer provides the control, orchestration and scheduling of network resources based on requests from the application layer. The requirements of the controller layer of bDDN include the following aspects:

– Network control layer is required to provide a programming interface for the network applications.
– Network control layer is required to collect resource information from the network infrastructure layer.
– Network control layer is required to accept instructions from the network application layer and control and schedule network resources based on the instruction.

– Network control layer is required to transform instructions from the network application layer to resource configuration information that can be understood by the network infrastructure layer.
– Network control layer is required to support dynamic, autonomous control on network resources, including dynamic network resources registration, dynamic network resource scheduling, etc.
– bDDN system is required to guarantee the data integrity and security when data is transmitted from the network control layer to the network infrastructure layer.

8.3 Requirements for network infrastructure layer

The network infrastructure is where the network elements perform the transporting and the processing functions of data packets according to the decisions made by the network controller. To support big data driven capabilities, the network infrastructure layer of bDDN is required to support the following requirements:

– Network infrastructure layer is required to transport and process data packets according to the decisions made by the network control layer.
– Network infrastructure layer is required to provide flow control capability when data is exchanged between the network infrastructure layer and the network control layer.
– Network infrastructure layer is required to guarantee the data integrity and security when data is transmitted from the network infrastructure layer to the network control layer.
– Network infrastructure layer is required to provide network traffic sensing support based on rules or policies set up by network control layer.
– Network infrastructure layer is required to provide network programmability capability for the network control layer.
– bDDN system is required to report resource status to the network control layer.
– A network infrastructure's main function is user traffic processing and forwarding. While supporting network visibility is important, the network sensing is just an auxiliary function and it should not impede normal traffic processing and forwarding (i.e., the performance is not lowered and the behaviour is not altered due to the telemetry functions).
– The network operation applications require end-to-end visibility from various sources, which results in a huge volume of data. However, the collection data quantity should not stress the network bandwidth, regardless of the data delivery approach (i.e., through in-band or out-of-band channels).
– The network infrastructures must provide the data in a timely manner with the minimum possible delay. Long processing, transport, storage, and analysis delay can impact the effectiveness of the control loop and even render the data useless.
– The network plane telemetry should support incremental deployment and work even though some devices are unaware of the system. This challenge is highly relevant to the standards and legacy networks.

9 Requirements of management plane for big data driven networking

9.1 Network marketing operation

With the evolution of network, faster speed and warmer service brings customers a better experience. Network operators can achieve elaborate and intelligent operation strategies and methods based on big data grasped by network or management systems. bDDN can facilitate network marketing operations for network operators while the following requirements shall or should be supported by bDDN:

– bDDN is required to collect data that are related to QoS/QoE of customers.

NOTE – For example, some information that can describe delay, real-time bandwidth, customers complaints, etc.

– bDDN is recommended to establish statistics models to analyse customers' experience for network services by synthetically using the collected QoS/QoE information.

– bDDN is recommended to predict customers' objectives or requirements, and make personalized operation strategy for customers based on the statistics models.

– bDDN is required to support analysis for a group of customers that are correlated and make operation strategy for the customers based on analysis.

– bDDN is required to provide results of analysis and prediction to the upper layer application such as OSS/BSS.

9.2 Network planning and engineering

When mobile customers use the services provided by mobile network operators, there is big data generated both in the user plane and signal plane. By analysing them comprehensively, users' actual experience in their using of services can be known. According to the experience of users within the same base station, the question of whether the base station is poor or not can be judged. Reasonable and intelligent network planning such as increasing the quantity or expanding the capacity of the base station can then be carried out to improve the quality of service for the mobile network efficiently.

Similarly, network planning is also important in a fixed network context.

The following are some requirements related network planning and engineering for bDDN:

– bDDN is required to provide a reasonable and intelligent base station capacity plan for operators using big data plane when bDDN is applied to mobile network.

– bDDN is required to provide capability of reasonable deployment planning for transport network for operators using big data plane.

– bDDN is required to provide capability of reasonable deployment planning for access network for operators using big data plane.

– bDDN is recommended to collect data from user plane and signal plane and store the data for a long period (e.g., three months or longer) when bDDN is applied to mobile network.

– bDDN is recommended to analyse long-time historical data from user plane and signal plane and store the analysed result for a long period when bDDN is applied to mobile network.

– bDDN is recommended to have the capability to plan the network based on information including the aforementioned analysed result.

10 Interface requirements for big data driven networking

10.1 Requirements for interfaces between layers of big data plane

Within the big data plane, the interface between the network sensing layer and network big data repository layer is represented by iSD, and the interface between the network analyser layer and data intelligence and service layer is represented by iAI.

The following are some requirements about the interface iSD

– bDDN is required to support at least one of the various protocols that can be used to collect network data, for example, SNMP, FTP, HTTP, etc.

– bDDN is recommended to support various protocols that can be used to collect network data, for example, SNMP, FTP, HTTP, etc.

– bDDN is required to provide real time data collection function.

The following are some requirements about the interface iAI

– bDDN is required to support one of the various protocols such as HTTP, RESTful or other protocols to provide service from network analyser layer to data intelligence layer.

– bDDN is recommended to support multiple protocols such as HTTP, RESTful or other protocols to provide service from network analyser layer to data intelligence layer.

10.2 Requirements for interface between big data plane and network plane

There is an interface between the network sensing layer (big data plane) and the network infrastructure layer (network plane). The interface is represented by iBN, and Figure 10-1 illustrates this interface, see also Figure 11-1 of [ITU-T Y.3650]. Requirements for the iBN interface are listed as follows:

– Network infrastructure layer is required to have the capability to provide data to network sensing layer through iBN interface.

– Network infrastructure layer is required to have the capability to guarantee basic functions of network plane not to be influenced by the iBN interface.

– Network infrastructure layer is recommended to have the capability to classify the data provided through the iBN interface with coarse grain.

– Network infrastructure layer is recommended to have the capability to negotiate the feature (for example data category, data sending speed and data structure, etc.) of the data provided through the iBN. interface.

– Network infrastructure layer is recommended to have the capability to accept the classification rules on which the data provided through the iBN interface can be classified with coarse grain.

– iBM interface is required to support at least one of the management or application layer protocols including SNMP, HTTP, FTP, etc. for iBM interface.

– iBM interface is recommended to support multiple management or application layer protocols including SNMP, HTTP, FTP, etc. for iBM interface.

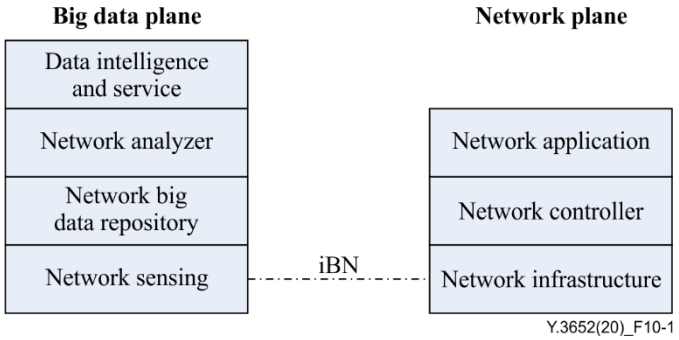

Figure 10-1 – Interface between network sensing layer and network infrastructure layer

10.3 Requirements for interface between big data plane and management plane

There is an interface between the big data plane and the management plane. The interface is represented by iBM, see Figure 11-2 of [ITU-T Y.3650]. Some iBM interface requirements are listed as follows.

– bDDN is required to provide an analysis function of network faults or failure causes through the iBM interface for the management plane.
– bDDN is required to provide a network optimization analysis function through the iBM interface for the management plane.
– bDDN is required to provide a precision marketing operation function through the iBM interface for the management plane.
– bDDN is required to provide active maintenance information through the iBM interface for the management plane.
– bDDN is required to support collection of a management plane data function through the iBM interface.
– bDDN is required to support at least one of the management or application layer protocols including SNMP, HTTP, FTP, etc. for the iBM interface.
– bDDN is recommended to support multiple management or application layer protocols including SNMP, HTTP, FTP, etc. for the iBM interface.

10.4 Requirements for interface between domains of big data plane

There is an interface between the bDDN control domains, it is called the domain-domain interface (DDI), see clause 8 of [ITU-T Y.3650]. The DDI interface should meet the following requirements:

– The DDI interface shall provide reliable transfer of data and signalling messages.
– Performance of the DDI interface should be matchable to the data carried in the interface.
– bDDN is recommended to use an out-of-band network to carry the data through the DDI interface.
– bDDN is recommended to use a special security logical channel (e.g., virtual private network interface) to carry the data through the DDI interface when an out-of-band network is not possible.

11 Security considerations

While implementing requirements related to big data driven networking, security best practices should be adopted such as authentication, authorization and access control and described in [ITU-T Y.2704].

In addition, big data that are used to implement requirements related to big data driven networking should be protected in order to avoid leaking and being destroyed.

In the meantime, operations related to network resources should have multiple reliability guaranteeing measures in order to avoid incorrect operation of network resources and causing the degrading of network performance.

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