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Draft new Recommendation ITU-T Y.bDDN-Mec-IPP

Big data driven networking - mechanism for customer-oriented intent perception and processing

1 Scope

This draft recommendation specifies the mechanism for customer-oriented intent perception and processing in big data driven networking (bDDN). The scope includes following aspects:

- 1) Overview of customer-oriented intent perception and processing based on bDDN;
- 2) General mechanism for customer-oriented intent perception and processing in bDDN;
- 3) Mechanism for customer-oriented intent perception and processing in each plane of bDDN;
- 4) Interfaces related to mechanism for customer-oriented intent perception and processing in bDDN;
- 5) Security considerations.

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 Y.3184] ITU-T Recommendation ITU-T Y.3184 (2023), *Mechanism for intelligent awareness of network status*.
- [ITU-T Y.3172] ITU-T Recommendation ITU-T Y.3172(2019), *Architectural framework for machine learning in future networks including IMT-2020*.
- [ITU-T Y.3600] ITU-T Recommendation ITU-T Y.3600(2015), *Big data - Cloud computing based requirements and capabilities*.
- [ITU-T Y.3650] ITU-T Recommendation ITU-T Y.3650 (2018), *Framework of big-data-driven networking*.
- [ITU-T Y.3652] ITU-T Recommendation ITU-T Y.3652(2019), *Requirements of big data driven networking*.
- [ITU-T Y.3653] ITU-T Recommendation ITU-T Y.3653 (2021), *Big data driven networking-Functional architecture*.
- [ITU-T Y.3654] ITU-T Recommendation ITU-T Y.3654 (2022), *Big data driven networking – Machine learning mechanism*.
- [ITU-T Y.3531] ITU-T Recommendation ITU-T Y.3531(2020), *Cloud computing – Functional requirements for machine learning as a service*.
- [ITU-T Y.3115] ITU-T Recommendation ITU-T Y.3115 (2022), *AI enabled cross-domain network architectural requirements and framework for future networks including IMT-2020*.
- [ITU-T Y.IBN-reqts] Draft Recommendation ITU-T Y.IBN-reqts, *Scenarios and requirements of Intent-Based Network for network evolution*.
- [ITU-T Y.Arch-INRA] Draft Recommendation ITU-T Y.Arch-INRA, *Functional architecture for intelligent awareness of network requirements*

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3 Definitions

3.1 Terms defined elsewhere

3.1.1 big data (b-ITU-T Y.3600)

A paradigm for enabling the collection, storage, management, analysis and visualization, potentially under real-time constraints, of extensive datasets with heterogeneous characteristics.

3.1.2 big data driven networking(bDDN) (ITU-T Y.3650)

bDDN is 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.

3.1.3 machine learning (ML) (ITU-T Y.3172)

Processes that enable computational systems to understand data and gain knowledge from it without necessarily being explicitly programmed.

3.1.4 machine learning model (ITU-T Y.3172)

Model created by applying machine learning techniques to data to learn from.

NOTE 1 – A machine learning model is used to generate predictions (e.g., regression, classification, clustering) on new (untrained) data.

NOTE 2 – A machine learning model may be encapsulated in a deployable fashion in the form of a software (e.g., virtual machine, container) or hardware component (e.g., Internet of Things(IoT) device).

NOTE 3 – Machine learning techniques include learning algorithms (e.g., learning the function that maps input data attributes to output data).

3.1.5 Closed loop (ITU-T Y.3115)

A type of control mechanism in which the outputs and behaviour of a system are monitored and analysed, and the behaviour of the system is adjusted so that improvements may be achieved towards definable goals.

NOTE 1 – Observe, Orient, Decide and Act (OODA) [b-OODA], MAPE-K [b-MAPE-K] are examples of closed loop mechanism.

NOTE 2 – Examples of definable goal types are optimization of network resources' utilization and automated service fulfilment and assurance. Goals may be defined using declarative mechanisms.

NOTE 3 – The system may consist of a set of managed entities, workflows and/or processes in a network.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

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4 Abbreviations

This Recommendation uses the following abbreviations and acronyms:

5G	fifth generation
AI	artificial intelligence
bDDN	big-data-driven networking
DL	deep learning

IoT	internet of things
ML	machine learning
IBN	intent-based networking
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5 Conventions

In this Recommendation:

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

The keywords "can optionally" and "may" indicate an optional requirement which is permissible, without implying any sense of being recommended. This term is not intended to imply that the vendor's implementation must provide the option, and the feature can be optionally enabled by the network operator/service provider. Rather, it means the vendor may optionally provide the feature and still claim conformance with this Recommendation.

6 Introduction

As the network continues to evolve, the complexity of the existing network's management, operation, and maintenance has increased dramatically with the heterogeneity of network nodes and the enhancement of network dynamics, while the traditional manual-based network management is inefficient and difficult to support the continuous development of the network.

Therefore, the concept of Big Data-driven Networking emerged and has been widely researched. Big data-driven networking (bDDN) is a framework for providing big data services and network intelligence, which contains three planes: the network plane, the data plane, and the management plane. It drives the enhancement of the level of intelligence in network management, operation, control, optimization, and security through the automated flow of big data in the network.

In addition, intent-based network (IBN) has been a popular research topic in recent years, and both 3GPP and ETSI have standards related to IBN. While the industry has not yet defined all the details of IBN in a uniform manner, there is agreement on the philosophy and core elements of IBN, which can be summarized as a closed-loop network mechanism that is automatically constructed and operated according to human intent under the condition of knowing the global state of the network.

Based on the bDDN network architecture and utilizing its functional entities and mechanisms, such as network sensing, data analytics, AI algorithms, and intelligent services, it is possible to effectively percept the intent of network customers, and accurately process them into the corresponding customer-oriented network strategies. Ultimately, the network will evolve from a static resource system to a dynamic system that can meet user demands in real time.

NOTE 1 – The ultimate target of customer-oriented is to meet the individual needs of customers and enhance customer personalized experience, rather than just keep the network itself working properly.

NOTE 2 – The scope of the term "intent" encompasses not only the users' intent that the network actively senses from the traffic data, but also the intent that the network passively receives from the network users or network operators through natural language processing.

NOTE 3 – Intent perception based on bDDN is a step or a procedure to sense user's intent and translate them into corresponding network policies through the big data plane and network plane in bDDN.

NOTE 4 – Intent processing based on bDDN is a step or a procedure to process the translated intent and manage intent's lifecycle through the big data plane and management plane in bDDN.

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7 Overview of customer-oriented intent perception and processing based on bDDN

The intent perception module is capable of sensing network users' intent. Combine with intelligent awareness of network status, it can translate intent into corresponding network policies and configurations. In this process, big data plane of bDDN will provide intent perception module with AI services such as machine learning, deep learning, and natural language processing.

Then, the intent processing model sends network policies and configurations to the network through the management plane of bDDN. Based the functionalities of big data plane of bDDN, the intent processing module can evaluate whether the intent is realized by continuously monitoring and analyzing network status information from network plane of bDDN.

The intent here primarily refers to the intent of the network customer, but intent can also come from network providers and network administrators. The ultimate target is to meet the individual needs of customers and enhance the personalized experience.

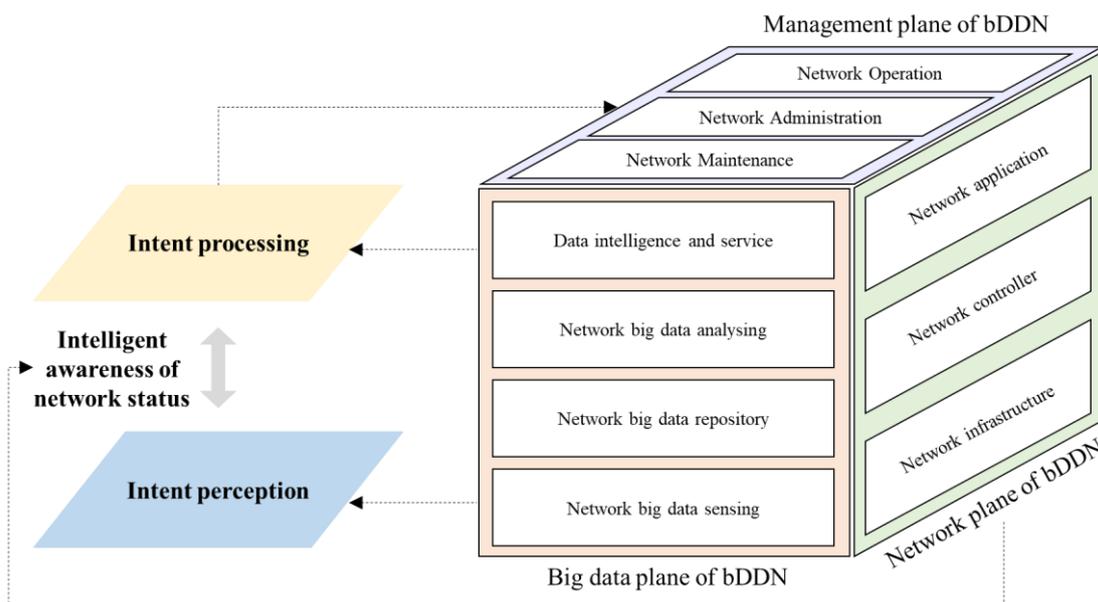


Figure 7-1 – Overview of customer-oriented intent perception and processing based on bDDN

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8 General mechanism for customer-oriented intent perception and processing in bDDN

The general mechanism for customer-oriented intent perception and processing in bDDN is shown in Figure 8-1. The big data plane support intent perception and processing module and network status intelligent awareness module by providing capabilities such data analysis and machine learning.

The intent perception and processing converged function can improve the automation and intelligence of the network, providing mobile networks with network AI functions such as precise planning, anomaly detection, network optimization, root cause analysis, alarm prediction, and fault self-healing. More importantly, it can analyze the users' awareness and personalized needs for network in different space-time scenarios, thereby accurately matching network resources and customer need and improving the performance of operations and services across the board.

Intelligent awareness of network status module performs real-time sensing of network status information for network plane of bDDN. By analyzing network status, it can obtain network topology, traffic characterization, fault information, service information, etc.

Through the closed loop inside the intent perception and processing module and the closed loop between intent perception and processing module and intelligent network status awareness module,

the network is capable of achieving agile and precise service scheduling and optimization, dynamic and intelligent matching of service supply and personalized demand services, thereby supporting the three types of services of management plane in bDDN: network maintenance, network administration, and network operation (ITU-T Y.3650).

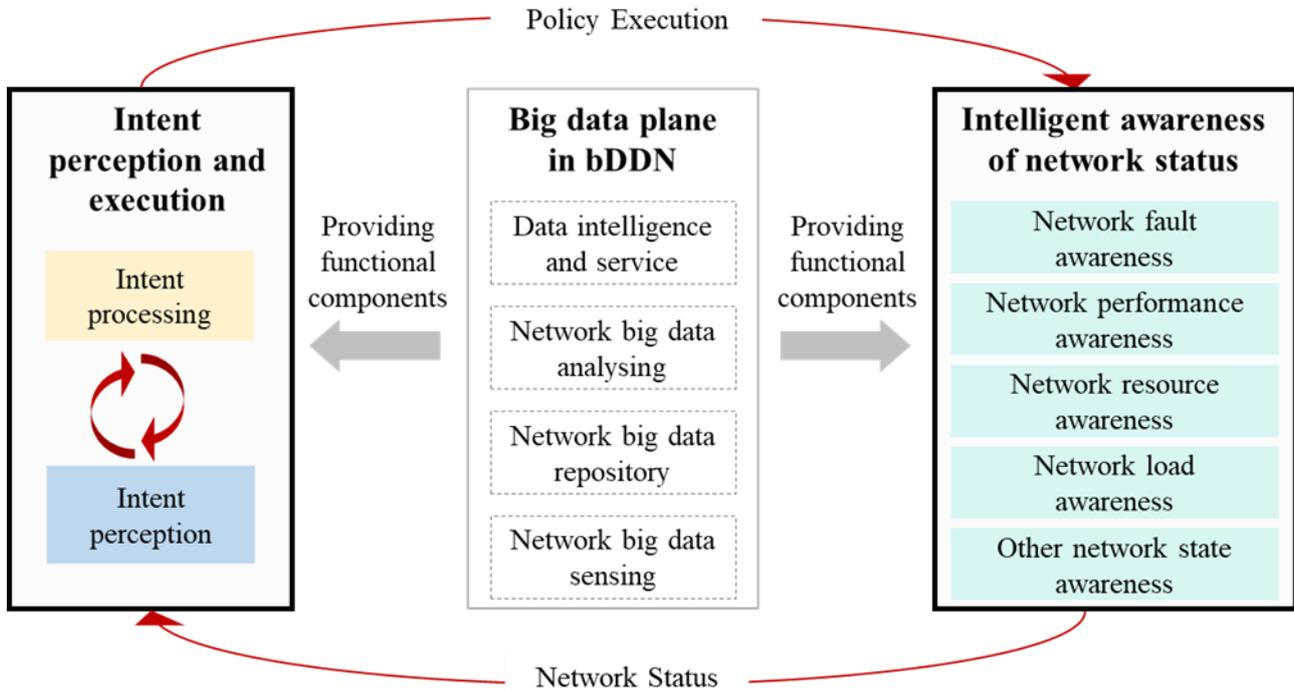


Figure 8-1 – General mechanism for customer-oriented intent perception and processing in bDDN

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9 Mechanism for customer-oriented intent perception and processing in each plane of bDDN

9.1 Mechanism for customer-oriented intent perception and processing in big data plane

<TBD>

9.2 Mechanism for customer-oriented intent perception and processing in management plane

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9.3 Mechanism for customer-oriented intent perception and processing in network plane

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10 Interfaces related to mechanism for customer-oriented intent perception and processing in bDDN

<TBD>

11 Security considerations

<TBD>

Appendix I Gap Analysis

Organizations and projects	Description	Gap Analysis
<p>ITU-T SG13 ITU-T Y.3654</p>	<p>Recommendation ITU-T Y.3654: “Big data driven networking - Machine learning mechanism” (ex Y.bDDN-MLMec)</p> <p>This Recommendation specifies the mechanisms of machine learning in big data driven networking, its scope includes the following aspects: 1) Overview; 2) Learning procedure; 3) Deployment; 4) Related interfaces; 5) Learning and control path; 6) Security considerations.</p>	<p>ITU-T Y.3654 focuses on the Machine learning mechanism of bDDN, Machine learning is one of the many techniques of artificial intelligence. It considers using the existing data set for model training to obtain the optimal parameter set. Then predict the labels or attributes of new unknown samples in bDDN.</p> <p>However, this new proposal is the mechanism of customer-oriented intent perception and processing based on bDDN, focusing on intent perception and processing, which mainly utilizes the artificial intelligence technology of bDDN's big data plane to perceive the network intent, and combines it with the intelligent awareness of network status to convert the intent into the corresponding network policies and configurations, and does not primarily focus on the machine learning mechanism of bDDN.</p> <p>Thus, the proposal won't be overlapping with the scopes from ITU-T Y.3654.</p>
<p>ITU-T SG13 ITU-T Y.3650</p>	<p>Recommendation ITU-T Y.3650: “Framework of big-data-driven networking”</p> <p>This Recommendation specifies a framework for big-data-driven networking. The scope of this Recommendation includes the model architecture of big-data-driven networking (bDDN), the high-level capabilities of bDDN and the interface capabilities among different planes and layers.</p>	<p>Recommendation ITU-T Y.3650 focuses on bDDN itself and specifies a framework for bDDN. The scope of this Recommendation includes the model architecture of the Big Data Driven Network (bDDN), the high-level functionality of the bDDN, and the interface functionality between the different planes and layers.</p> <p>This new proposal is based on bDDN, not studying bDDN itself. It focuses on how to utilize the functionality of the big data plane of the bDDN and combine with the intelligent awareness of network status to convert the intent into the corresponding network policies and configurations, which are sent down from the management plane to the network plane, thus forming a closed loop of optimization.</p> <p>Thus, the proposal won't be overlapping with the scopes from ITU-T Y.3650.</p>
<p>ITU-T SG13 ITU-T Y.3652:</p>	<p>Recommendation ITU-T Y.3652: “Requirements of big data driven networking”</p> <p>This Recommendation specifies requirements of big data driven networking. The scope of this Recommendation includes: 1) general requirements for big data driven networking; 2) requirements of big data plane for big data driven</p>	<p>Recommendation ITU-T Y.3652 focuses on bDDN itself and specifies bDDN's requirements. It mainly includes general requirements for big data driven networking, requirements of big data plane, requirements of network plane, requirements of management plane and interface requirements.</p> <p>However, this new proposal does not focus on bDDN itself. It focuses on how to utilize the functionality of the big data plane of the bDDN and combine with the intelligent</p>

	<p>networking; 3) requirements of network plane for big data driven networking; 4) requirements of management plane for big data driven networking; 5) interface requirements for big data driven networking; 6) security aspect requirements for big data driven networking.</p>	<p>awareness of network status to convert the intent into the corresponding network policies and configurations, which are sent down from the management plane to the network plane, thus forming a closed loop of optimization.</p> <p>Thus, the proposal won't be overlapping with the scopes from ITU-T Y.3652.</p>
<p>ITU-T SG13 ITU-T Y.NGNe-IBN-arch</p>	<p>Draft new Recommendation ITU-T Y.NGNe-IBN-arch: "Functional architecture of NGN evolution by adoption of Intent-Based Network"</p> <p>This draft Recommendation provides the general functional architecture of NGNe by adoption of the Intent-Based Network, specifies its functional entities and defines the functionalities of these functional entities. In addition, reference points will also be addressed in this draft Recommendation. Intent-Based Network is a high level network which support traditional network management system and also incorporate new technologies including software defined networking and network function virtualization especially from the network evolution perspective. This draft Recommendation builds on Y.IBN-reqts, and the content of this draft recommendation is aligned with Y.IBN-reqts and ITU-T Y.IMT2020-IBNMO.</p>	<p>Recommendation ITU-T Y.NGNe-IBN-arch focuses on the functional architecture of the network, and is primarily an intent-based network realization of that architecture. The main new addition to this architecture is the improvement of the NICE architecture by the Intent Orchestration Functional Realization, specifically at the service and transport layers.</p> <p>This new proposal does not focus on the functional architecture. It focuses on the mechanisms. The target of this new proposal is to study how to utilize the functional components of the bDDN to realize the customer-oriented intent perception and processing, rather than utilizing the IBN to realize the updates to the network architecture.</p> <p>Thus, this proposal won't be overlapping with the scope of ITU-T Y.NGNe-IBN-arch.</p>
<p>ITU-T SG13 ITU-T Y.AN-Arch-fw</p>	<p>Draft new Recommendation ITU-T Y.AN-Arch-fw: "Architecture framework for Autonomous Networks"</p> <p>This Recommendation provides requirements, architecture components and related sequence diagrams which together comprises an architecture framework for autonomous networks. The scope of this Recommendation includes: 1) Requirements for the architecture; 2) Description of the architecture and its components; 3) Sequence diagrams explaining the interactions between the architecture components.</p>	<p>This Recommendation specifies the architecture framework of Autonomous Networks and provides the requirements, architecture, and sequence diagrams explaining the interactions between the architecture components of an autonomous network. In this Recommendation , the autonomous network is a network which can generate, adapt, and integrate controllers at run-time using network-specific information and can realize exploratory evolution, real-time responsive online experimentation and dynamic adaptation.</p> <p>However, this new proposal focuses on the mechanism of customer-oriented intent perception and processing. Intent perception based on bDDN is a step or a procedure to sense users' intent and translate them into corresponding network policies through the big data plane and network plane in bDDN. Intent processing based on bDDN is a step or a procedure to process the translated intent and manage intent's lifecycle through the big</p>

		<p>data plane and management plane in bDDN. Intent perception and processing can be considered as a component of realizing Autonomous Networks, but their connotations and emphasis are different.</p> <p>Thus, this proposal won't be overlapping with the scope of ITU-T Y.AN-Arch-fw.</p>
<p>ITU-T SG13 ITU-T Y.3179</p>	<p>Recommendation ITU-T Y.3179: “Architectural framework for machine learning model serving in future networks including IMT-2020”</p> <p>This Recommendation provides an architectural framework for machine learning (ML) models serving in future networks including IMT-2020, i.e., preparing and deploying ML models in different deployment environments to enable the application of ML model inference to ML underlay networks. The scope of this Recommendation includes: 1) Background and motivations; 2) High level requirements; 3) High-level architecture description including the definition of architectural components, reference points and sequence diagrams.</p>	<p>Recommendation ITU-T Y.3179 specifies an architectural framework for ML models serving in future networks including IMT-2020 by considering three fundamental stages, which are inference optimization, model deployment and model inference. It focuses on how to prepare and deploy ML models in different deployment environment. ML is a common AI technique which can be deployed in network to improve its intelligence.</p> <p>In the new proposal, although ML models will be deployed in the procedure of intent perception and processing based on bDDN, a series of other techniques will also be applied in this mechanism. More importantly, the new proposal mainly focuses on the mechanism of customer-oriented intent perception and processing in bDDN, which aims at helping bDDN evolve into a more dynamic system, matching network resources and services according to the real-time intent.</p> <p>Thus, this proposal won't be overlapping with the scope of ITU-T Y.3179.</p>
<p>ITU-T SG13 Y.IMT2020-IBNMO</p>	<p>Draft new Recommendation ITU-T Y.IMT2020-IBNMO: “Intent-based network management and orchestration for network slicing in IMT-2020 networks and beyond”</p> <p>This Recommendation aims to describe the intent-based network management and orchestration for network slicing in IMT-2020 networks and beyond. This recommendation covers the following items: 1)Requirements of intent-based network management and orchestration for network slicing in IMT-2020 networks and beyond; 2) The architecture of intent-based network management and orchestration for network slicing in IMT-2020 networks and beyond.</p>	<p>This project focuses on the scenario of network slicing, and aims to clarify the requirements, architecture, and representative mechanism of intent-based network management and orchestration in this Specific scenario in IMT-2020 networks and beyond.</p> <p>This new proposal is not limited to a specific network scenario. The intent perception and process can support general services in network maintenance, network administration, and network operation. It aims to describe how to perceive and process the users' intent based on bDDN, ultimately enhancing users' network service experience.</p> <p>Thus, this proposal won't be overlapping with the scope of ITU-T Y.IMT2020-IBNMO.</p>
<p>3GPP SA WG5 3GPP TR 28.812</p>	<p>Recommendation 3GPP TR 28.812: “Study on scenarios for Intent driven management services for mobile networks (Release 17)”</p> <p>The present document describes, intent driven management concept, intent driven management scenarios,</p>	<p>Recommendation 3GPP TR 28.812 focuses on scenarios, specifically the development of concepts, architectures, policies, and scenarios for intent driven management services. It does not address specific intent perception and processing.</p>

	<p>and recommendation for the way forward on standardization expression of the intent in normative phase.</p> <p>The present document considers below dimensions when studying Intent driven management.</p> <p>1) Users; The study covers the Technical (NOP, NEP) and Techno-Business (CSP); 2) Networks; The study covers the 5G and 4G; 3) Operated System; The study covers the Co-ordinated and Complex systems; 4) Infrastructure Automation; The study covers more Autonomous and less Automatic; 5) Language; The scope covers more declarative and less Imperative.</p>	<p>This new proposal focuses on mechanisms, not on application scenarios. It focus on the mechanism for achieving intent perception and processing based on bDDN. Intent driven management is not in the scope of this new work item.</p> <p>Thus, this proposal won't be overlapping with the scope of TR 28.812.</p>
<p>ITU-T SG13 ITU-T Y.2344</p>	<p>Draft new Recommendation ITU-T Y.2344: "Scenarios and requirements of Intent-Based Network for network evolution"</p> <p>This draft recommendation aims to study scenarios and requirements of Intent-Based Network for network evolution.</p> <p>The scope of this Draft Recommendation includes:</p> <p>1) Scenarios and workflow of Intent-Based Network for network evolution; 2) Capability requirements of Intent-Based Network for network evolution; 3) General framework and model architecture of Intent-Based Network for network evolution.</p>	<p>Recommendation ITU-T Y.2344 focuses on the scenarios and requirements of IBN, in particular architecture of IBN, including the Intent, Control and Network layers, and indicates the requirements of each layer of IBN for network evolution.</p> <p>This new proposal focuses on the mechanism for achieving customer-oriented intent perception and processing based on bDDN, rather than the scenarios and requirements. This proposal and does not focus on the functionality of each layer of the IBN and the requirements for the IBN.</p> <p>Thus, this proposal won't be overlapping with the scope of ITU-T Y.2344.</p>

Bibliography

[3GPP TR 28.812] 3GPP TR 28.812 (2020), *Study on scenarios for Intent driven management services for mobile networks V17.1.0.*

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Annex C

A.1 justification for proposed draft new ITU-T Y.bDDN-Mec-IPP "Big data driven networking – mechanism for customer-oriented intent perception and processing"

Question:	Q7/13	Proposed new ITU-T Recommendation	Geneva, 23 October – 3 November 2023	
Reference and title:	ITU-T Y.bDDN-Mec-IPP “Big data driven networking – mechanism for customer-oriented intent perception and processing”			
Base text:	SG13 TD294/WP2		Timing:	2025-Q4
Editor(s):	Chen Cheng, China Unicom, chengc40@chinaunicom.cn Jinyou Dai, CICT, PCL, djy@fiberhome.com Tianyi Wang, China Unicom, wangty65@chinaunicom.cn Ya’nan Zhang, China Unicom, zhangyn152@chinaunicom.cn Junrui Hao, CICT, PCL, haojr@wri.com.cn		Approval:	AAP
Scope: This draft recommendation specifies the mechanism for customer-oriented intent perception and processing based on big data driven networking (bDDN). The scope of the draft recommendation includes: <ul style="list-style-type: none"> – Overview of customer-oriented intent perception and processing based on bDDN; – General mechanism for customer-oriented intent perception and processing in bDDN – Mechanism for customer-oriented intent perception and processing in each plane of bDDN; – Interfaces related to mechanism for customer-oriented intent perception and processing in bDDN; – Security considerations. 				
Summary: Based on the bDDN network architecture and utilizing its functional entities, such as data sensing, intelligent services, network controller, and network operation, it is possible to effectively perceive the intent of network users and operators, and accurately process them into the corresponding customer-oriented network policies. The ultimate target of “customer-oriented” is to meet customers’ personalized network service needs and enhance customers’ network experiences, rather than simply keep the network itself working properly. In this new work item, the scope of the term "intent" encompasses not only the intent that the network actively senses and analyze from the user traffic, but also the intent that the network passively receives from the network users or network operators through AI capabilities such as natural language processing. Intent perception based on bDDN is a step or a procedure to sense users and operators’ intent and translate them into corresponding network policies through the big data plane and the network plane in bDDN. On the other hand, intent processing based on bDDN is a step or a procedure to process the translated intent and manage intent's lifecycle through the big data plane and the management plane in bDDN. The intent perception and processing help bDDN evolve into a more dynamic system, matching network resources and services according to the real-time intent. Although both 3GPP and ETSI have been working on network management and orchestration related to the intent-base network, this new work item mainly focuses on the mechanism for realizing intent perception and processing capabilities based on the architecture and functionalities of bDDN.				
Relations to ITU-T Recommendations or to other standards (approved or under development): ITU-T Y.3650, ITU-T Y.3652, ITU-T Y.3653, ITU-T Y.3654, ITU-T Y.3172, ITU-T Y.3531, ITU-T Y.3180				
Liaisons with other study groups or with other standards bodies: 3GPP SA WG5, ETSI ENI ISG				
Supporting members that are committing to contributing actively to the work item: China Unicom, China Information Communication Technologies Group Corporation, Peng Cheng Laboratory, Beijing University of Posts & Telecommunication				