

## **Draft new Recommendation ITU-T Y.REOUPF**

### **Resource efficiency optimization for managing user plane function in IMT-2020 networks and beyond**

#### **Summary**

This draft new Recommendation clarifies the requirements, architecture and procedures for resource efficiency optimization for managing user plane function in IMT-2020 networks and beyond.

#### **Keywords**

Resource efficiency; management and orchestration; IMT-2020 networks and beyond

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## **Draft new Recommendation ITU-T Y.REOUPF**

### **Resource efficiency optimization for managing user plane function in IMT-2020 networks and beyond**

#### **1. Scope**

This Recommendation specifies resource efficiency optimization for managing user plane function in IMT-2020 networks and beyond. It addresses the following subjects:

- Overview of resource efficiency optimization for managing user plane function in IMT-2020 networks and beyond;
- Requirements for resource efficiency optimization for managing user plane function in IMT-2020 networks and beyond
- Architecture of resource efficiency optimization for managing user plane function in IMT-2020 networks and beyond
- Procedures of resource efficiency optimization for managing user plane function in IMT-2020 networks and beyond
- Security consideration

#### **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.3100] Recommendation ITU-T Y.3100 (2017), *Terms and definitions for IMT-2020 network*.
- [ITU-T Y.3110] Recommendation ITU-T Y.3110 (2017), *IMT-2020 network management and orchestration requirements*.
- [ITU-T Y.3104] Recommendation ITU-T Y.3104 (2018), *Architecture of the IMT-2020 network*.
- [ITU-T Y.3150] Recommendation ITU-T Y.3150 (2020), *High-level technical characteristics of network softwarization for IMT-2020*.
- [ITU-T Y.3535] Recommendation ITU-T Y.3535 (2022), *Cloud computing-Functional requirements for a container*.
- [ITU-T Q.5025] Recommendation ITU-T Q.5025 (2022), *Protocol for managing User Plane function in IMT-2020 network*.

#### **3. Definitions**

##### **3.1 Terms defined elsewhere**

This document uses the following terms defined elsewhere:

**3.1.1 IMT-2020** [ITU-T Y.3100]: Systems, system components, and related technologies that provide far more enhanced capabilities than those described in [b-ITU-R M.1645].

### **3.2. Terms defined in this Recommendation**

This Recommendation defines the following terms:

*Editor's note: Terms will be added according to further update of the texts*

## **4. Abbreviations and acronyms**

This Recommendation uses the following abbreviations and acronyms:

SDN	Software Defined Network
NFV	Network Function Virtualization
VNF	Virtualized Network Function
UPF	User Plane Function

## **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" 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. Overview**

A large number of emerging vertical industrial applications (such as vehicular communication, IoT, remote surgery, etc.) are expected to come with differentiated network resource requirements for IMT-2020 networks and beyond, especially for the user plane function (UPF), which provides connection between end users and various data networks. Network softwarization specified in [ITU-T Y.3150] is realized by introducing software-defined networking, network functions virtualization, and other key technologies to IMT-2020 networks to abstract underlying heterogeneous physical infrastructure as virtual network, computing and storage resources. The network functions (NFs, such as UPF and other control plane functions) are shifted from dedicated hardware devices to efficient software implementations running on general purpose servers as virtualized network functions. Edge computing specified in [ETSI GS MEC series] facilitates the UPF distributedly deployed at the network edge close to users to pre-process application data locally. And the containerization technologies defined in [ITU-T Y.3535] enable the UPF implemented by VM/container instances through lightweight virtualized resources, to further improve resource utilization. However, the

varying data traffic dynamics and fast mobility of requests generated by end users put forward diverse flexibility and elasticity of highly efficient resource orchestration demands on UPF, and service stability needs to be taken into consideration at the same time. The various types and amount of resources raise the complexity and difficulty of resource management and orchestration for geographically distributed UPFs in IMT-2020 networks and beyond, which makes it hard to achieve highly efficient resource utilization and service stability.

There are some related research activities including the protocol procedure management triggered UPF energy saving specified in [ITU-T Q.5025], in which resource management and orchestration architecture and related functionalities are not mentioned; the virtual resource management for energy efficiency described in [b-ITU-T Y.IMT-2020 REEM], in which UPF specific features (e.g., distributedly deployed, edge computing and containerized-enabled, etc.) related to resource management are not mentioned; and [b-3GPP TS 28.310] provides energy efficiency measurements and a certain use case of switch-off edge UPF in 5G, and does not focus on the resource management and orchestration for UPF. Therefore, it is necessary to further optimize the resource management and orchestration of UPF enabled by edge computing and containerization in IMT-2020 networks and beyond.

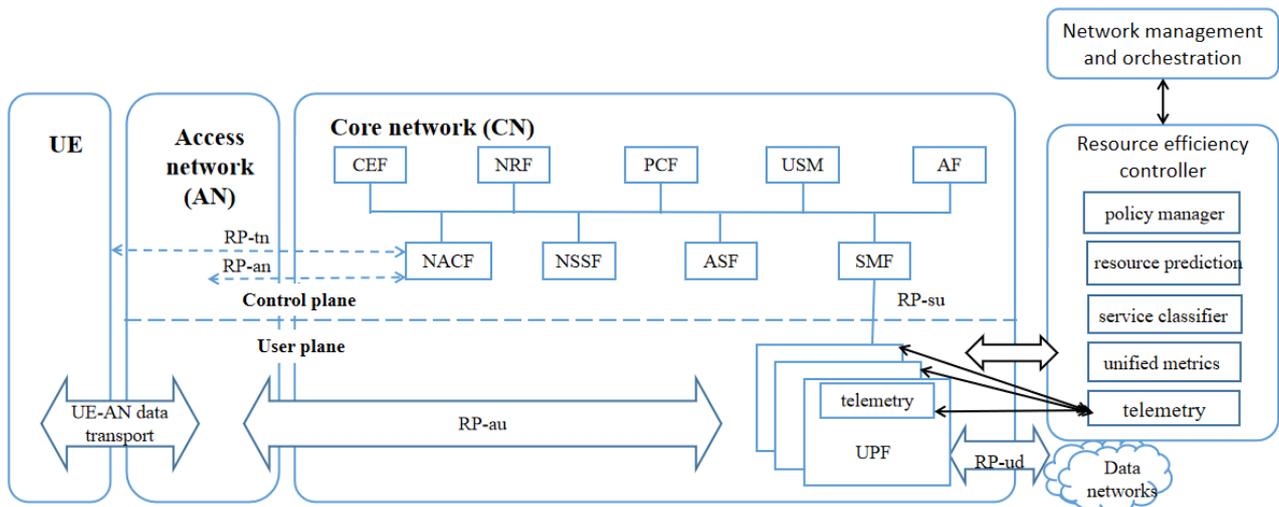


Figure 6-1 Overview of resource efficiency optimization for managing user plane function in IMT-2020 networks and beyond

Figure 6-1 shows the overview of resource efficiency optimization for managing UPF in IMT-2020 networks and beyond from a high-level perspective, it includes: network management and orchestration, resource efficiency controller, and the telemetry and other functionalities deployed in UPF.

The network management and orchestration is responsible for dynamically elastic scheduling (workload aware-based scheduling, network topology aware-based scheduling, rescheduling, etc.) and automatically scaling for various resources (VM/ container instances, replicas, etc.) of UPF

based on resource efficiency policy ( e.g., triggered by prediction, periodically, monitoring), and it provides service stability assurance at the same time.

The resource efficiency controller provides telemetry, unified metrics, service classifier, resource prediction, and policy manager functionalities. The telemetry functionality deployed in UPFs which is implemented by edge computing and containerization to collect and pre-process the data of network traffic, network status, session numbers, user mobility aware data, service performance and quality, resource state (reserved resource, actual resource usage) and log data, and sends it to the telemetry functionality in controller. The telemetry functionality in controller coordinates with telemetry functionality in UPFs. And then, unified metrics are established according to the telemetric data analysis, to provide parameters for the UPF resource prediction. The service classifier classifies the service carried on UPFs into three types: the high priority online services, low priority online services, and offline services, to ensure the service stability according to its priority and types. The resource prediction provides proactive and reactive prediction for differentiated resources in. The policy manager interacts with the network management and orchestration system and provides resource optimization policy about resource recommendation for instances/ replicas number of UPF, capacity planning, etc.

#### **7. Requirements for resource efficiency optimization for managing user plane function in IMT-2020 networks and beyond**

*Editor's note: This clause will describe the requirements for resource efficiency optimization for managing UPF in IMT-2020 networks and beyond. These may include, but not limited to, general requirements, requirements on network functionalities, UPF, etc.*

#### **8. Architecture of resource efficiency optimization for managing user plane function in IMT-2020 networks and beyond**

*Editor's note: This clause will describe the architecture of resource efficiency optimization for managing UPF in IMT-2020 networks and beyond. It may include, but not limited to, network functions of UPF, network resource management and orchestration functionalities, etc.*

#### **9. Procedures of resource efficiency optimization for managing user plane function in IMT-2020 networks and beyond**

*Editor's note: This clause will describe the procedures of resource efficiency optimization for managing UPF in IMT-2020 networks and beyond. It may include, but not limited to, the information flow of resource efficiency optimization execution steps between the network functions of UPF and the resource efficiency controller, the resource efficiency controller and the network management and orchestration, etc.*

#### **10. Security Considerations**

*Editor's note: This clause will describe the security consideration.*

## **Bibliography**

[b-ITU-R M.1645] Recommendation ITU-R M.1645 (2003), *Framework and overall objectives of the future development of IMT-2000 and systems beyond IMT-2000*.

[b-ITU-T Y.IMT-2020 REEM] Recommendation ITU-T Y.IMT-2020 REEM, *Energy efficiency management of virtual resources in IMT-2020 networks and beyond*.

[b-3GPP TS 28.310 ] TS 28.310 v17.4.0 (2022), *Technical Specification Group Services and System Aspects; Management and orchestration; Energy efficiency of 5G (Release 17)* .

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