

I n t e r n a t i o n a l T e l e c o m m u n i c a t i o n U n i o n

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

Q.3316

(02/2016)

SERIES Q: SWITCHING AND SIGNALLING

Signalling requirements and protocols for the NGN –
Resource control protocols

Interface and signalling requirements and specification for cross stratum optimization

Recommendation ITU-T Q.3316

ITU-T

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Recommendation ITU-T Q.3316

Interface and signalling requirements and specification for cross stratum optimization

Summary

The cross stratum optimization (CSO) function is introduced to support carrier services for instance cloud services efficiently. The CSO function is aware of resource usage across the service stratum and transport stratum and is therefore able to optimize control and management of resource usage. Recommendation ITU-T Q.3316 defines interface and signalling aspects to fulfil this function.

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History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T Q.3316	2016-02-13	11	11.1002/1000/12699

Keywords

Cross stratum optimization, CSO, resource control and management function, virtual network for carriers, VNC, vRCMF.

* To access the Recommendation, type the URL <http://handle.itu.int/> in the address field of your web browser, followed by the Recommendation's unique ID. For example, <http://handle.itu.int/11.1002/1000/11830-en>.

FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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Recommendation ITU-T Q.3316

Interface and signalling requirements and specification for cross stratum optimization

1 Scope

This Recommendation defines the interface and signalling requirements and specification for cross stratum optimization (CSO) based on the resource control and management architecture defined in [ITU-T Y.3014].

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 Q.3302.1] Recommendation ITU-T Q.3302.1 (2010), *Resource control protocol No. 2 (rcp2) – Protocol at the Rp interface between transport resource control physical entities*.
- [ITU-T T.50] Recommendation ITU-T T.50 (1992), *International Reference Alphabet (IRA) (Formerly International Alphabet No. 5 or IA5) – Information technology – 7-bit coded character set for information interchange*.
- [ITU-T Y.3014] Recommendation ITU-T Y.3014 (2016), *Resource control and management function for virtual networks for carriers (vRCMF)*.
- [IEEE 754] IEEE 754 (2008), *Standard for Binary Floating-Point Arithmetic*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 carrier [ITU-T Y.3014].

3.1.2 customer [ITU-T Y.3014].

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ACCT	protocol connection establishment Accept
ASON	Automatically Switched Optical Network
CLOSE	protocol connection establishment Close
CRPFE	Customer Request Processing Functional Element
CSO	Cross Stratum Optimization
DNS	Domain Name System
EN	Event Notification

FE	Functional Entity
HMAC	Hash-based Message Authentication Code
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
KA	Keep-Alive
MIB	Management Information Base
OAM	Operation, Administration, and Maintenance
OPEN	protocol connection establishment Open
OTN	Optical Transport Network
PMFE	Profile Mapping Functional Element
QoS	Quality of Service
QREP	Query Reply
RA	Resource Acceptance
RCIP	Resource Connection Initiation Protocol
REJ	resource Rejection
RLP	Resource reLease Response
RLR	Resource reLease Request
RQ	Resource Query
RR	Resource Request
RSVP-TE	Resource reservation Protocol – Traffic Engineering
SRCM-FE	Service Resource Control and Management – Functional Entity
SRCM GFE	Service Resource Control and Management Gateway Functional Element
SRCM-PE	Service Resource Control and Management – Physical Entity
TCP	Transmission Control Protocol
TRCM-FE	Transport Resource Control and Management Functional Entity
TRCM GFE	Transport Resource Control and Management Gateway Functional Element
TRCM-PE	Transport Resource Control and Management Physical Entity
TRC-PE	Transport Resource Control – Physical Entity
TRMFE	Transport Resource Management Functional Element
TROFE	Transport Resource Optimization Functional Element
TRPFE	Transport Resource Provisioning Functional Element
TRRFE	Transport Resource Repository Functional Element
VM	Virtual Machine
VNC	Virtual Network for Carriers
vRCMF	Resource Control and Management Function for virtual networks for carriers
VRMFE	Virtual Resource Management Functional Element
VROFE	Virtual Resource Optimization Functional Element

VRPFE	Virtual Resource Provisioning Functional Element
VTRFE	Virtual Topology Repository Functional Element

5 Conventions

None.

6 Interface requirements for cross stratum optimization

A cross stratum optimization (CSO) function follows the resource control and management architecture shown in Figure 6-1 as defined in [ITU-T Y.3014] to support a virtual network for carriers (VNC).

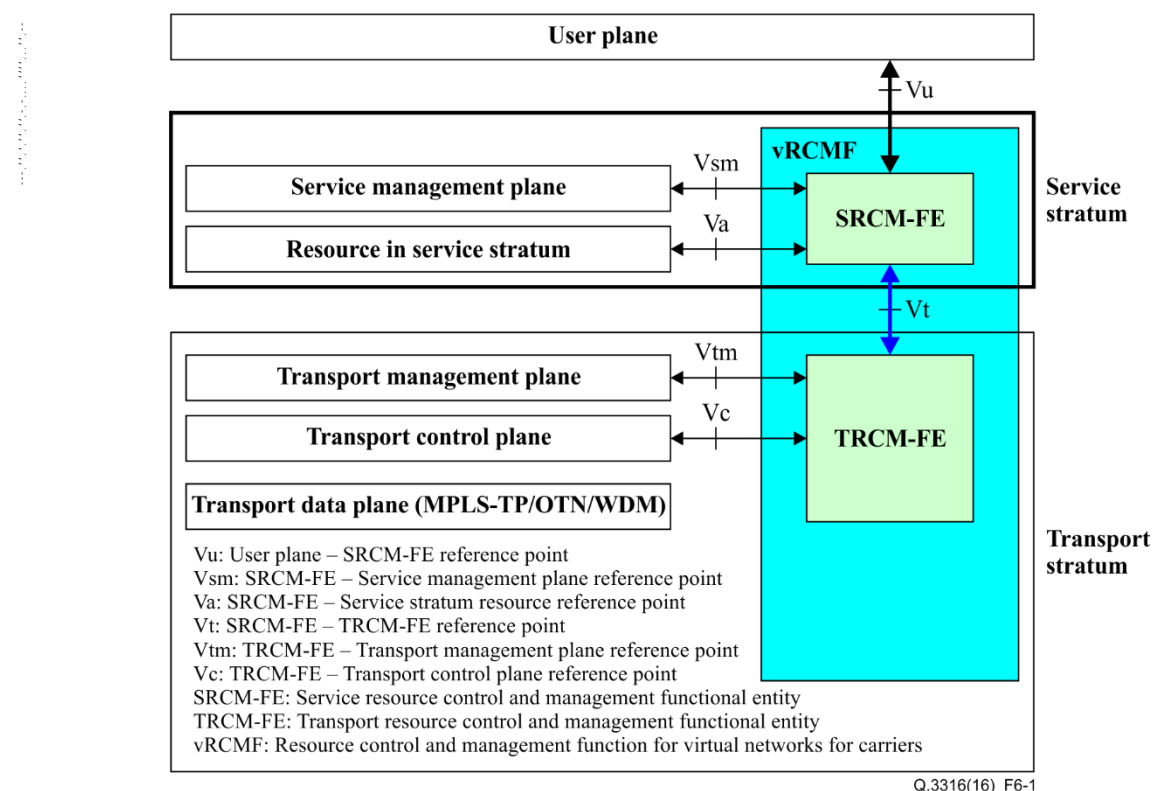


Figure 6-1 – Resource control and management high-level architecture for VNC

To accomplish the CSO function, the service resource control and management – functional entity (SRCM-FE) in the service stratum communicates with transport resource control and management – functional entity (TRCM-FE) in the transport stratum via Vt.

6.1 Vt reference model

In order to describe the signalling requirements of Vt, service resource control and management – physical entity (SRCM-PE) and transport resource control and management – physical entity (TRCM-PE) are used. Figure 6-2 shows the reference model for CSO signalling between SRCM-PE and TRCM-PE via Vt.

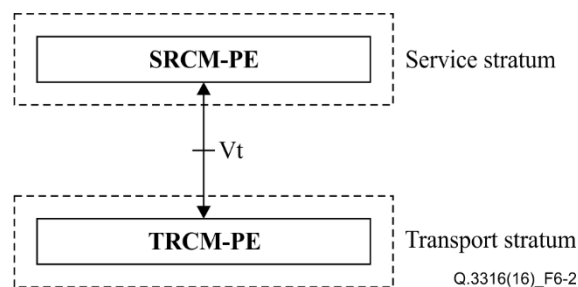


Figure 6-2 – Vt signalling reference model

The interface Vt allows resource queries from/to the service stratum to/from the transport stratum. It also allows reservation requests from the service stratum to the transport stratum for certain mission-critical applications that demand guaranteed bandwidth reservation with a minimal latency. In addition, Vt can be used to exchange status data for monitoring, control, and management purposes across the strata.

6.2 Functional elements and capabilities

6.2.1 SRCM-PE

SRCM-PE is able to receive and process user request to initiate the CSO function. The cross stratum optimization is performed based on the collected status of virtual resources (e.g., servers, storage) in the service stratum and the transport resource information received from TRCM-PE. Figure 6-3 shows the SRCM-PE functionality. The SRCM-PE functionality and its relationship with other neighbour functional entities are defined in clause 8.1 of [ITU-T Y.3014].

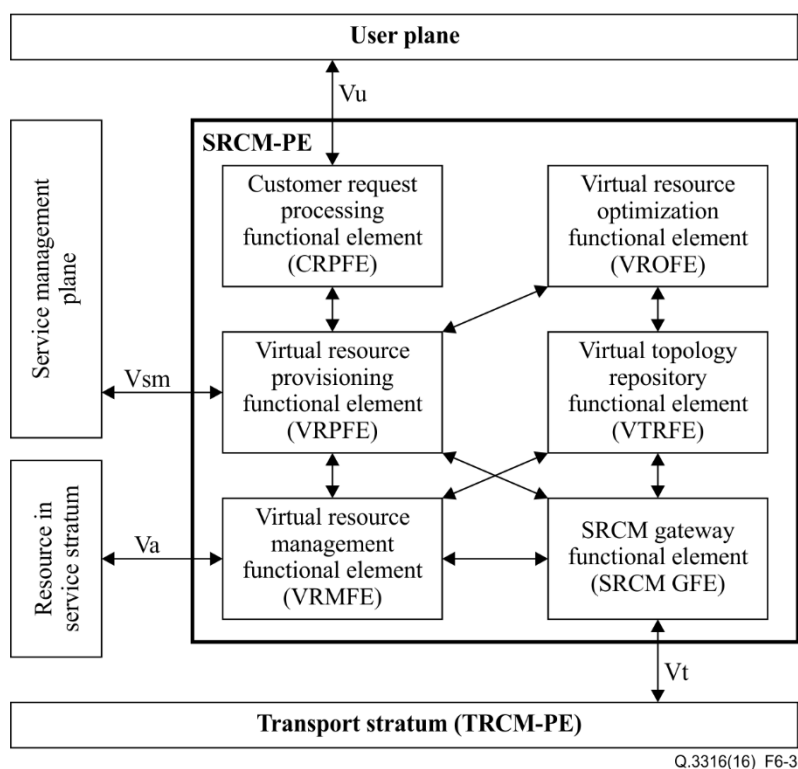


Figure 6-3 – SRCM-PE functionality

6.2.2 TRCM-PE

TRCM-PE receives a service profile/request from SRCM-PE and initiates provisioning of the transport resources (e.g., network elements and related capabilities) to meet the service requirements.

TRCM-PE is also able to provide abstract and virtualized information about the transport stratum to SRCM-PE. Figure 6-4 shows the TRCM-PE functionality. The TRCM-PE functionality and its relationship with other neighbour functional entities are defined in clause 8.1 of [ITU-T Y.3014].

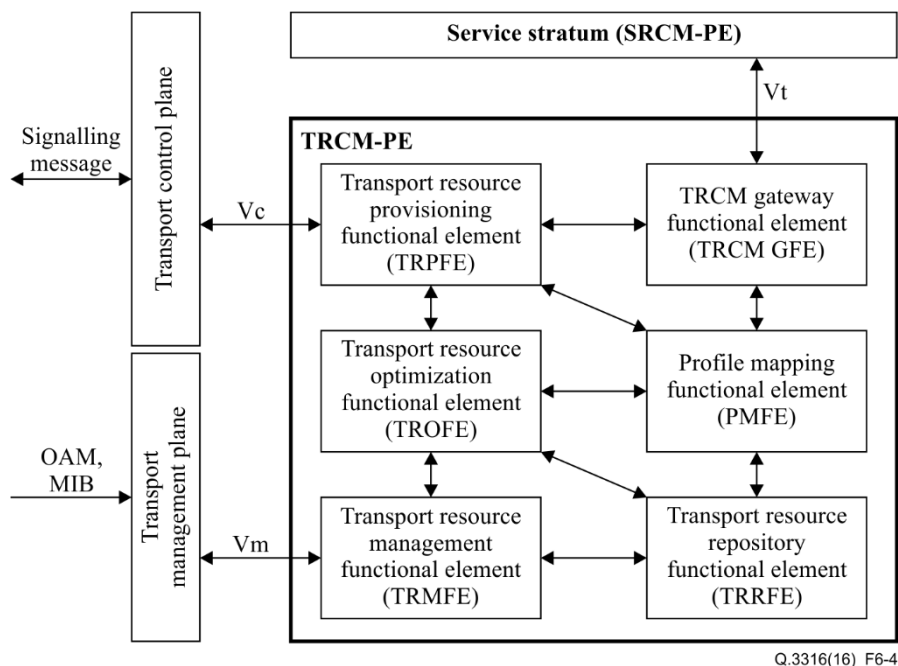


Figure 6-4 – TRCM-PE functionality

7 Signalling requirements for CSO

7.1 Query from SRCM-PE to TRCM-PE

SRCM-PE sends a query message to TRCM-PE to get the status of the resources in the transport stratum, with which SRCM-PE is able to do cross stratum optimization calculation. There is no actual resource reservation and allocation at this stage.

SRCM-PE sends a request message to TRCM-PE to set up a new path or modify an existing path in the transport stratum, with which resource reservation and allocation is required. All the requirements, together with the constraints for path reservation, such as bandwidth, latency and scheduling features, need to be specified in the request message.

7.2 Response from TRCM-PE to SRCM-PE

TRCM-PE sends a response message to the query message from SRCM-PE to feed back the status of the resources in the transport stratum.

TRCM-PE sends a response message to the request message from SRCM-PE to indicate if the request is committed successfully or not.

7.3 Network event and status notification to SRCM-PE

The resources, events and status of the network are reported from TRCM-PE to SRCM-PE, e.g., resource outage or connection failure.

When an alternative solution is found to satisfy a scheduled transport service after the resource reservation, but before the service initiation, TRCM-PE sends an event notification message to SRCM-PE to provide the alternative solution while reserving the resources for it. The choice between the alternative and previous solutions for re-optimization purposes will be determined by SRCM-PE.

After receiving the event notification message, SRCM-PE sends a message to TRCM-PE containing the selection of the chosen solution. This message applies only for scheduled transport services.

8 Procedures

8.1 Resource query

In order to support optimization across the service stratum and the transport stratum, the former needs to be aware of the abstracted resource information of the underlying transport network. The resource query mechanism can be used to collect such information.

- The service resource control and management gateway functional element (SRCM GFE) sends a transport resource query message to the transport resource control and management gateway functional element (TRCM GFE) in TRCM-PE. The message may contain a set of application source/destination locations through which the application can access to the transport network. The resource query message may also include other service constraints such as bandwidth, maximum latency and maximum jitter. Specifically, SRCM GFE can also query the scheduling related parameters, such as a specific time interval.
- The TRCM GFE performs the authentication and admission control on the message and then forwards it to the profile mapping functional element (PMFE).
- The PMFE maps: the set of application source/destination locations into addresses of network source/destination locations; the set of application time intervals into the network scheduled information; and the service constraints into technology-dependent network constraints. The mapping result is forwarded to the transport resource optimization functional element (TROFE).
- The TROFE estimates, on the basis of each pair of network source/destination locations:
 - whether there are enough transport resources to create a potential path that satisfies the constraints;
 - whether there is an appropriate time interval to support the creation of a potential path that satisfies the scheduling constraints;
 - the performance of a potential path, e.g., latency, jitter and load rate along the path.
- The estimation result, i.e., the set of potential paths with related information, is forwarded to the PMFE. Note that the detailed route of each path may be hidden for various reasons, e.g., a security policy restriction placed at the transport network or scalability considerations.
- The PMFE generates a query response message carrying the estimation result and forwards it to the TRCM GFE.
- The TRCM GFE sends the query response message to the SRCM GFE. Therefore, the SRCM-PE can store the estimation result in the virtual topology repository functional element (VTRFE) for the purpose of joint optimization.

8.2 Transport resource reservation

The service stratum can request resource reservation from the transport stratum for carrier services (e.g., cloud service). Such a procedure may be triggered by different application events, e.g., bulk virtual machine (VM) migration and backup or restore of storage:

- The virtual resource optimization functional element (VROFE) makes a joint optimization calculation based on the estimation result received from the TRCM-PE by the SRCM GFE and stored in the VTRFE and the virtual resource status managed by the virtual resource management functional element (VRMFE), and determines the optimal way to fulfil the application task. For example, to perform VM migration or data backup from a source cloud server, the VROFE may choose the optimal destination cloud server that has sufficient virtual