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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN).

1 Scope

The present document presents an overall analysis of architectural requirements for QoS reporting and resource monitoring (i.e. QoS handling). This includes analysing management aspects from an architectural perspective (stage 2) as well as taking into account the work on performance and QoS for Next Generation Networks undertaken by STQ.

The area of QoS reporting covers detecting the end-to-end QoS experienced by bearer flows, while the area of resource monitoring covers monitoring the topologies and resources of the transport segments controlled by RACS. Resource monitoring includes detecting the actual usage of these resources.

The present document provides an informative description of the QoS handling tasks that are to be performed. It further describes how different subsystems, common functions or capabilities, and management systems interact in performing these tasks.

Being an informative document providing an overall analysis of QoS handling area it is foreseen to be referenced by the RACS release 2 specification [1] and potentially other specifications impacted by QoS handling, but it only performs a preliminary architectural analysis. New functions or interfaces for QoS Handling will not be part of the normative document of the RACS release 2 specification [1]. The present document does not define or re-define functions or interfaces needed for QoS handling. Instead, such enhancements are expected to be made in normative documents such as the RACS specification, beyond current release.

2 References

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2.1 Informative references

[1] ETSI ES 282 003: "Telecommunications and Internet Converged Services and Protocols for Advanced Networking (TISPAN); Resource and Admission Control Sub-system (RACS); Functional Architecture".

[2] ETSI TS 181 018: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); Requirements for QoS in a NGN".

3 Definitions and abbreviations

3.1 Definitions

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

QoS reporting: this mechanism identifies the ability for some network elements to collect the values of some QoS metrics of a single service instance

NOTE: Example of QoS metrics could be delay, packet loss, etc.

resource monitoring: this mechanism identifies the ability to monitor the topologies and resources of the transport segments controlled by RACS. Resource monitoring includes detecting the actual usage of these resources.

3.2 Abbreviations

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

AF	Application Function
AN	Access Node
A-RACF	Access-Resource and Admission Control Function
AS	Application Server
ATM	Asynchronous Transfer Mode
BGF	Border Gateway Function
BoD	Bandwidth on Demand
CAC	Call Admission Control
CDR	Call Detail Record
CPE	Customer Premises Equipment
IP	Internet Protocol
OSS	Operation Support System
PCR	Peak Cell Rate
QoS	Quality of Service
QRC	QoS Reporting Collector
QRS	QoS Reporting Source
QRU	QoS Reporting User
RACS	Resource Admission Control Subsystem
RCEF	Resource Control Enforcement Function
SNMP	Simple Network Management Protocol
SPDF	Service-based Policy Decision Function
TRIM	Topology and Resource Information Model
TRIS	Topology and Resource Information Specification
TRSF	Topology and Resource Storage Function
VC	Virtual Circuit
VP	Virtual Path
x-RACF	Generic-Resource and Admission Control Function

4 Resource Monitoring

RACS provides policy based transport control services to application functions (i.e. QoS control). These services may include policy control, resource reservation, policing, gate control and IP address mediation. Implementing such services RACS needs to hold a logical view of the different transport segments within its control. This view is kept up-to-date and potentially also reflect the actual usage of the network in case traffic sources send at variable rates or in case not all flows are under the control of RACS.

Hence, for RACS to perform resource monitoring it needs functions and reference points to retrieve and store a logical view of the different transport segments within its control. This view is herein described in the form of a logical topology and resource information model (TRIM), which is stored by RACS in the form of a topology and resource information specification (TRIS).

Clause 4.1 discusses the general principles in retrieving, storing and keeping TRIS up-to-date to facilitate efficient resource control by RACS. Clause 4.2 describes the concrete information of TRIS and the mechanisms involved in retrieving, storing and keeping TRIS up-to-date with the transport segments it models.

4.1 General principles of Resource Monitoring

RACS needs to maintain accurate and current knowledge of resources available in the transport segments within its control and knowledge of which resources will be involved in forwarding individual media flows through these transport segments (i.e. the topology and resource information captured by TRIS). This information is needed by RACS for it to locate all the necessary functional entities and Transport Processing Entities (e.g. SPDF, A-RACF, BGF, RCSF and AN instances), that need to be involved in serving reservation requests issued over Gq'. The A-RACF uses TRIS to perform effective resource admission control for guaranteed forwarding quality of service (QoS).

4.1.1 Overview

The topology and resource information is expected to be stored locally by functional entities within RACS. That is, interrogating other functions on a per-request basis may delay the replies to reservation requests made over Gq' and Rq. The information stored locally by each functional entity may not be the complete TRIS for all transport segments controlled by a specific RACS instantiation. An SPDF instance needs only to have access to the information required to serve requests arriving over Gq', while an A-RACF instance only needs to have information to serve requests made over Rq available (i.e. information to interrogate the correct AN and/or RCEF and to perform admission control if guaranteed forwarding QoS is to be offered).

The status of the monitored resources allows the A-RACF to perform resource admission control for the path to protect the involved forwarding resources from overload.

The topology information may be learned by means of a provisioning integration for run-time interaction with OSS system(s) and/or by interacting with network devices.

4.1.2 Brief description of scenarios

In annex A of TS 181 018 [2] four scenarios are described that are related to the use of a Resource Monitoring mechanism which will enable a TISPAN NGN to provide an adequate Quality of Service to the media flows.

The following scenarios are derived from the above and illustrate examples where resource monitoring mechanisms are needed to provide accurate and up-to-date network resource and topology information to enable RACS to perform correctly in response to requests for admission control.

4.1.2.1 L2 Topology awareness and traffic management options

Scenario A.2 "L2 Topology awareness and traffic management options" [2] describes the case where the RACS has to control an ATM-based access network. Focusing on Connection Admission Control mechanism within an ATM network different approaches can be used. The simplest form among all CAC algorithms, is the so-called Peak Bandwidth Allocation that uses only the knowledge of the PCR parameter to compare against the network available bandwidth and decide whether to accept the configuration of new connection or not. This algorithm ensures that the sum of requested resources and existing connections is bounded by the physical link capacity, but prevents any multiplexing gain among the VC and VP configured into the network. Another approach is to admit new connection allocating a bandwidth between the peak cell rate and the sustained cell rate. As a result, the sum of all the admitted connections' peak cell rates may be greater than the outgoing link capacity.

If a statistical approach is used in the ATM network, RACS is aware of the exact network topology and knows for example the different overbooking factors used in all the interfaces of the various ATM switches. Then, the resource monitoring mechanism allows the RACS to be aware of L2 topology information in order to control an ATM-based access network. In this case the RACS needs to have a map of the network topology, able to model the link that will be affected by the traffic flow and other parameter as VPs and VCs.

Since the RACS is able to control network based on different technology and different deployments, a mechanism is needed in order to retrieve the topology and resource information for different networks and to allow the RACS to know all the information necessary to perform a correct admission control. Moreover, also the topology and resource information model (TRIM) and the topology and resource information (TRIS) maintained by the RACS is independent of the network technology and particular deployments.

NOTE: Further scenarios are possible and contributions are invited.

4.1.2.2 Bandwidth on Demand

Scenario A.4 "Bandwidth on Demand" [2] describes a service offered to a user which allows the user to boost his access bandwidth to a higher level for a limited period of time.

The objective is to study the requirements on the RACS functionalities to deliver such a service. The service would allow users who usually have e.g. 512 Kbps of access bandwidth available to increase this to a higher bandwidth, e.g. 2 Mbps, for a limited period of time.

The service could offer a number of options:

1) Request for increased downstream bandwidth for a specified time. This would allow the user to e.g. download content at a higher rate than normal. In this case only downstream traffic would need to be boosted.

2) Request for increased bi-directional bandwidth for a specified time. This would allow the user to e.g. share content or take part in a video conference and enjoy an improved image and sound quality.

3) Request for increased bandwidth for a specific service which would only affect the traffic associated with that service, e.g. a "Video Boost" service.

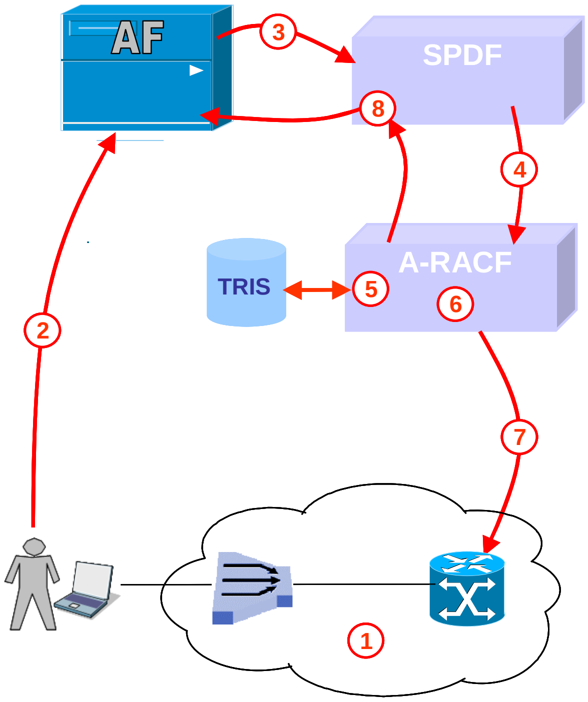
4) Request for increased bandwidth for some specific content.

Note that any of the options above (time based, service based and content based) could be combined.

The traffic affected by a bandwidth change may be all of the traffic to/from a particular subscriber or only a specific subset related to the given service requested. For example, in option 3) above only the video traffic would benefit from the newly available bandwidth. Also, depending on the service requested, bandwidth changes may have an impact on upstream and/or downstream traffic.

Bandwidth rates and the services to which they apply may be explicitly requested by the user or the user may request pre-defined policies. The request could be performed through a web portal. When explicitly requesting a bandwidth rate, the user includes sufficient information to identify the traffic that should be boosted. When requesting a pre-defined policy, the user minimally indicates the policy s/he wants to activate. In this last scenario the user/web portal may be unaware of the specific bandwidth change that RACS will apply in the network since RACS will hide this information.

Figure 1 represents an example of a possible realization of this service.



1. We assume the User CPE Network Session is already established and that the user policy can be applied. There may or may not be a default policy applied
2. A User logs into the Portal and selects to activate the BoD Service
3. The portal forwards the request onto the SPDF (includes User Identifier and BoD Profile to apply)
4. SPDF uses the User IP address or numeric identifier to map the request to an A-RACF
5. Admission Control Policy in the A-RACF uses TRIS information to determine whether there are sufficient resources to admit the request (assume yes)
6. A new network policy set is constructed for this request.
7. BoD Policy Rule is applied to the RCEF and/or AN
8. A-RACF gives positive request response to SPDF which forwards confirmation to user through the Portal

Figure 1: Bandwidth-on-Demand Scenario

The sequence of operations is as follows:

- The user logs on to a web portal and selects the BoD service.
- The Web Portal forwards the request to the SPDF including a user identifier (e.g. IP address or numeric identifier) plus an indication of quantity for bandwidth boost (this may be explicitly indicated in the request, or it is possible to reference pre-defined BoD classes).
- The SPDF uses the user identifier to map the request to an appropriate A-RACF.
- The A-RACF accesses information from the TRIS, if needed via TRSF, to determine whether there are sufficient network bandwidth resources to admit the request (we assume there are).
- A new policy set is constructed and applied in the network for the user according to the quantity of bandwidth requested.
- A positive response is forwarded to the user.
- If the Admission Control fails, the user is notified, and no upgrade is configured.

This scenario illustrates the need for current topology and resource information to be available to RACS to allow accurate allocation of resources for new requests. The topology and resource information is maintained in the form of the TRIS as discussed in clause 4.2.2. Implementation of the storage medium for TRIS and its location are for further study but are discussed in annex F to [1].

4.1.3 Preferred functional properties

The topology and resource information maintained by RACS (i.e. TRIS) should be independent of the network technology and particular deployments. That is, the actual information stored by RACS may differ between different network technologies and deployments, but the information model used to maintain the required knowledge should be the same for all network technologies and deployments.

Although TRIS is network technology and deployment independent the protocols used to retrieve resource topology and state information can be network technology specific. For example, a protocol used to retrieve the information may have different profiles or parameters to support specific network technologies.