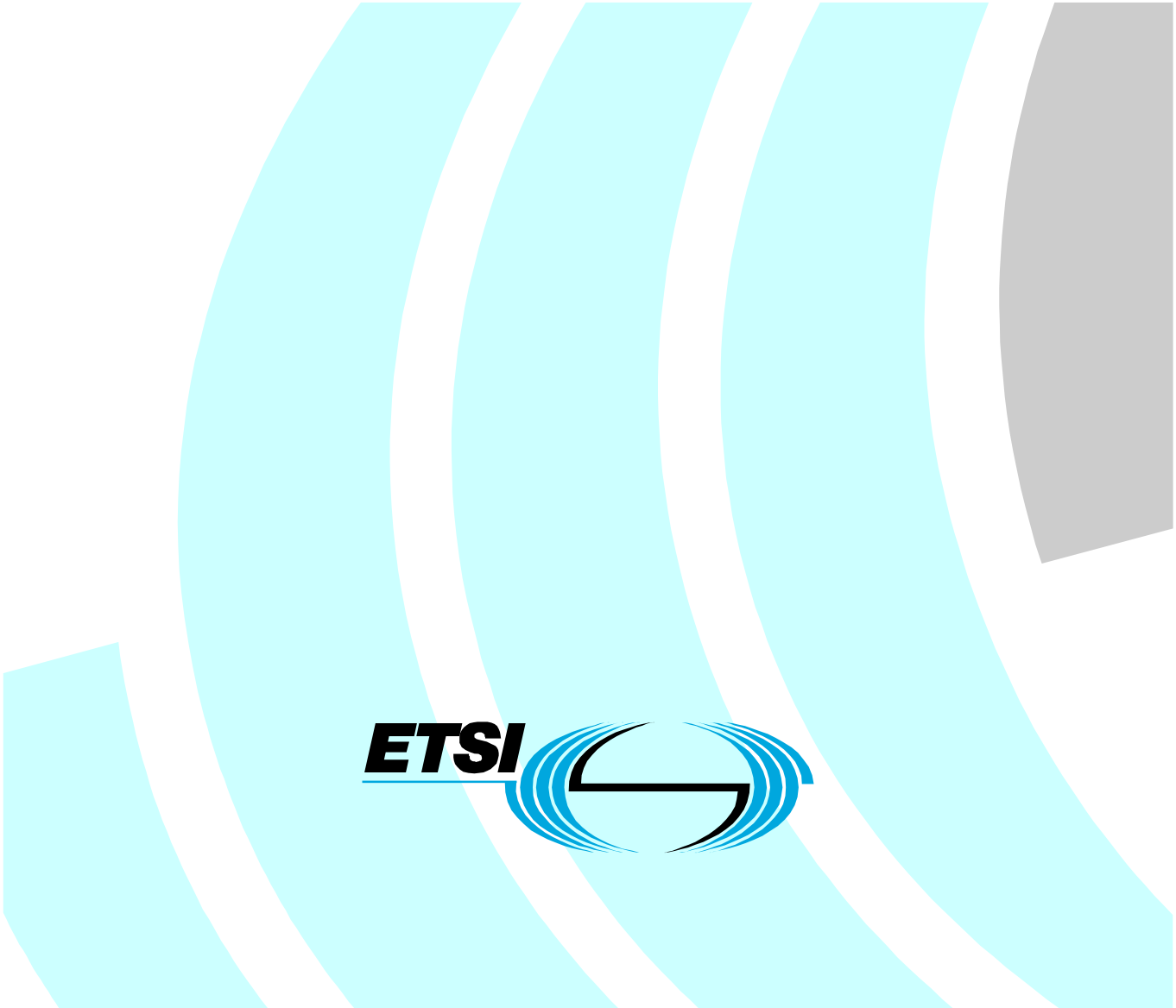
ETSI TR 182 013 V1.1.1 (2006-06)

Technical Report

Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); Bearer Control; Stage 2 Requirements



Reference
DTR/TISPAN-02024-NGN

Keywords
bearer, control

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
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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 identifies a range of issues which occur if Bearer Control Function communicates with each other. The present document is based on concepts developed in ITU-T Q.Sup51: "Signalling Requirements For IP-QoS". The present document covers the part of NCI (Network Control Interface) interface which provides multiple bearer routes between source and destination.

2 References

For the purposes of this Technical Report (TR) the following references apply:

[1] ITU-T Recommendation H.360: "An architecture for end-to-end QoS control and signalling".

[2] ITU-T Recommendation Y.1291: "An architectural framework for support of Quality of Service in packet networks".

[3] ITU-T Q.Sup51: "Signalling Requirements For IP-QoS ".

[4] ITU-T Recommendation E.360.1: "Framework for QoS routing & related traffic engineering methods for IP-, ATM-, & TDM-based multiservice networks".

[5] ITU-T Recommendation E.360.2: "QoS routing & related traffic engineering method- call routing & connection routing methods".

[6] ITU-T Recommendation E.360.3: "QoS routing & related traffic engineering method - QoS resource management methods".

[7] ITU-T Recommendation E.360.4: "QoS routing & related traffic engineering method - routing table management methods & requirements".

[8] ITU-T Recommendation E.360.5: "QoS routing & related traffic engineering method - transport routing methods".

[9] ITU-T Recommendation E.360.6: "QoS Routing & related traffic engineering method - capacity management methods".

[10] ITU-T Recommendation E.360.7: " QoS routing & related traffic engineering method - traffic engineering operational requirements".

[11] ITU-T Recommendation G.805: "Generic functional architecture of transport networks".

[12] ITU-T Recommendation Q.2981: "Broadband Integrated Services Digital Network (B-ISDN) and Broadband Private Integrated Services Network (B-PISN) call control protocol".

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

[14] MSF MSF-TR-QoS-001-FINAL: "Quality of Service for Next Generation Voice Over IP Networks".

[15] 3GPP TR 23.802: "Architectural Enhancements for End-to-End Quality of Service (QoS)".

NOTE: Also some of the above referenced URI Schemes are currently updated.

3 Definitions and abbreviations

3.1 Definitions

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

bearer: connection for the transport of user plane information between users involved in a communication

NOTE: Derived from [12].

Bearer Control Function (BCF): functional entity that performs the Resource and Admission Control functions related to QoS requests as well as routing functions

NOTE: Derived from [12].

connection: "transport entity" which consists of an associated pair of "unidirectional connections" capable of simultaneously transferring information in opposite directions between their respective inputs and outputs [11]

IP data Stream: sequence of packets sent to convey communication between the two endpoints identified by the Stream Information

Session Control Function (SCF): functional entity that provides the call/session control functionality

NOTE: Derived from [3].

Service Control Function (SvCF): functional entity that provides value-added service functionality

NOTE: Derived from [3].

stream information: information necessary to identify an IP data stream

Switching Function (SF): functional entity that performs stream classification, switching and forwarding

NOTE 1: I.e. QoS guarantee.

NOTE 2: Derived from [3].

3.2 Abbreviations

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

AF	Application Function
BCF	Bearer Control Function
MPLS	Multi-Protocol Label Switch
NASS	Network Access Subsystem
NCI	Network Control Interface
PDF	Policy Decision Function
QoS	Quality of Service
RACS	Resource And Control Subsystem
RCEF	Remote Control Emulation Function
SCF	Session Control Function
SCI	Switching Control Interface
SF	Switching Function
SPDF	Service Protocol Data Function
SvCF	Service Control Function
UE	User Equipment

4 Introduction

In order to tone up the satisfaction of the end user, we often provide multiple bearer routes in the bearer network. For example, when an end user make an IP call from source to destination, network provides route A for him; however, the QoS quality of route A is not good enough. When the end user ring off the call, and make the same call again, the network can change another route B for him.

If the bearer network is a network that there are multiple bearer routes between source and destination, the SCF can not make the routing judgement, and it should be done by BCFs. Thus need routing selection Information being commuted between BCF(s).

5 Functional Model

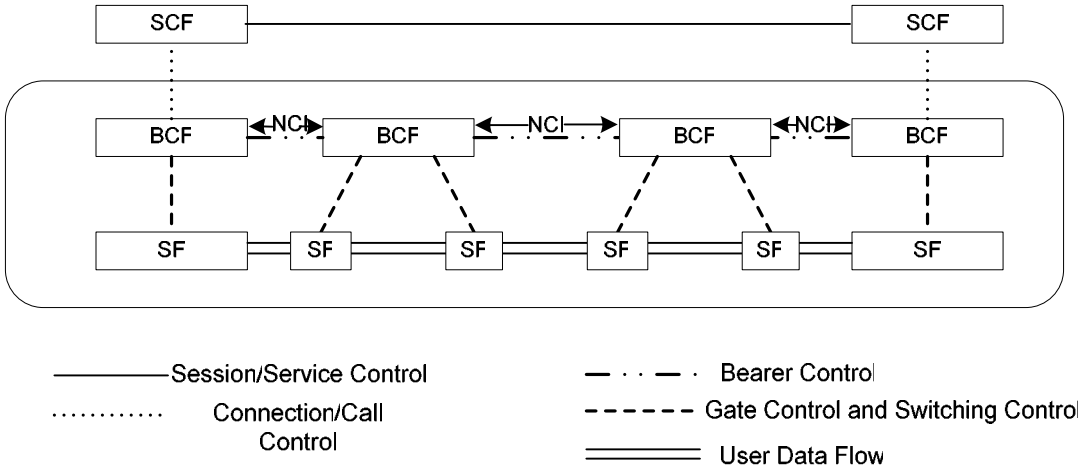

Figure 1: The functional model of bearer control requirements

Figure 1 depicts the functional model consisting of SCF, BCF, SF, and NCIs.

The functions are structured into 2 layers, namely the call and session layer and the transport layer. The transport layer is further subdivided into the bearer control plane and the transport plane. The bearer control plane is composed of the BCFs. In particular it does the resource calculation related to service request. (For the MPLS case, it is also responsible for path selection and resource allocation, which characterize the logical bearer network of this service type). The transport plane is composed of the SFs and the media source and sinks.

The proposed modular bearer control components and the interfaces that interconnect them relate to the functional model as follows:

a) **BCF**: BCFs (Bearer Control Functions) are responsible for establishing, modifying and releasing the network resources necessary to provide the negotiated arrangement. One BCF interacts with a peer BCF to establish and disconnect network facilities on a link-by-link basis. BCF components provide a generic and flexible connection model that encompasses multimedia call requirements.

   The BCF receives a QoS request from the SCF, based on a service stream. (For the MPLS case, the BCF performs service routing. For the non-MPLS case, it performs the identification of the logical path). After path-analysis, like service routing or the logical-path identification, it delivers the path-analysis results to the SF.

   The BCF needs certain network topology information and resource status information in order to be able to evaluate QoS requests and generate QoS configuration data.

b) **SCF**: An end user interacts with the SCF in order to request some service. The SCF initiate a QoS request, usually the SCF decides the parameters of a communications arrangement (such as bandwidth, quality of service, etc.). If an acceptable set of parameters can be negotiated, the SCF uses the services provided by the BCF to establish, maintain and disconnect the network resources necessary to provide the negotiated arrangement.

c) **SF**: SFs cross-connect a virtual connection at one port with a virtual connection at another port. Via one or more cross-connects at various SFs located between users, a virtual connection is created between the users. The characteristics of this virtual connection are based on the call parameters negotiated at the SCF level and the route is determined by BCF level. Based on instructions received over the SCI (Switching Control Interface), the SF controlled by the BCF creates and destroys cross-connects.

NOTE: For the MPLS case, it also performs MPLS transfer.

d) **NCI**: The NCI (Network Control Interface) is the interface between the functions of bearer control plane of transport layer.

6 Requirements

The QoS signalling (running on the Network control interface) in the bearer control plane should accomplish the following functions:

1) Request for resources to support service:

   The current BCF initiates a QoS request to the next hop BCF for an interface, with the following main parameters are:

   - Connection ID: the unique ID for each request. Each connection may contain multiple streams.
   - It is a requirement to have a "connection ID" to allow the sender and receiver to match a request with following responses, related modifications and cancellations. It is left for protocol design to determine which side generates that connection ID.
   - Stream information: Information to identify an IP data stream.
   - QoS parameters: A description of the service quality requirements of a stream. Many international standards are available for reference in this respect, hence no further description here.
   - Path information selected in the local domain and the previous domains (for the MPLS case: By means of consultation, data stream bearer path LSP sets are distributed between the BCFs, so conditions of LSP paths selected in the local domain and the previous domains should be provided for each other among BCFs, so that a peer BCF can correctly select a transit path LSP. For a bidirectional path, both forward path and backward path are available, such as MPLS label stack).

   Address information of the inter-domain interface: The address of the egress interface in the local domain (for the non-MPLS case).

2) Modification of resources to support service:

   In respect with some services, it may be necessary to modify the QoS requirements at any time during the service running. According to the request by the upstream BCF, a BCF modifies the bandwidth that was applied for use at the previous time. Multi-time modification is supported. Main parameters are:

   - Connection ID: The unique ID for each request. Each connection may contain multiple streams.
   - Stream information: Information to identify an IP data stream.
   - QoS parameters: A description of the service quality requirements of a stream. Many international standards are available for reference in this respect, hence no further description here.

3) Acceptance of request for resources to support service:

   Upon allocating the local domain resources, the BCF responds a piece of success information to the upstream BCF. Main parameters are:

   - Connection ID.

   Accepted QoS parameters: Among multi-optional QoS capabilities, the accepted QoS capability is selected.

   - Whole path information for the connection (for the MPLS case).

Address information of the inter-domain interface: The address of the egress interface in the local domain (for the non-MPLS case).

4) Rejection of request for resources to support service:

   When the BCF finds out that the QoS request of the upstream BCF cannot be satisfied, it will send a rejection response to the upstream BCF. Main parameters are:

   - Connection ID.
   - Rejection cause.

5) Report about resources to support service:

   In case of any change with the allocated bandwidth information (the resource seized by the connection is no longer available, etc.; for example), BCF should report it to the upstream BCF. Main parameters:

   - Connection ID.
   - Current status.

6) Release of resources to support service:

   The upstream BCF requests the downstream BCF for releasing the resource that has been requested for allocation. Main parameters are:

   - Connection ID.
   - Release cause.

7) Response for release for resources:

   The cancellation of resources should be confirmed to the upstream BCF. Main parameters are:

   - Connection ID.
   - Execution results.

7 Information flows

Within the signalling flows, the following functional entities have certain roles. They are described below.

Table 1: Roles of Functional Entities

Destination BCF	The destination BCF receives a QoS request based on a service stream, sent by the previous hop BCF. When it finds out that the destination IP of the service stream belongs to the BCF domain that is under its administration, if the request is a bidirectional one, the destination BCF will deliver the routing result of the QoS path from the destination to the source directly to the edge router, and return the response message of the QoS path from the source to the destination to the previous hop BCF.
Destination SF	The destination SF is an SF to which a certain service stream destination belongs. The destination SF transmits a data packet directly to a user or transfers it to another domain.
Initiator BCF	The Initiator BCF receives a QoS request based on a service stream, sent by the SCF. For the MPLS case it performs service routing, while for the non-MPLS case it performs the identification of the logical path.
Intermediate BCF	The intermediate BCF receives a QoS request based on a service stream, sent by the previous hop BCF, queries the BCF route table, provides distribution of resources in the local domain, and transfer the QOS request to the next hop BCF.
Source BCF	The source BCF receives a QoS request based on a service stream, sent by the SCF or the previous hop source seeking BCF. The source IP of the service stream belongs to the BCF domain that is under its administration.
Source seeking BCF	The source seeking BCF receives a QoS request based on a service stream, sent by the previous hop BCF, and queries the "Source BCF" route to find out the next hop BCF, to which it will transfer the request. The difference between the source seeking BCF and the intermediate BCF is that the former transfers a request for resources according to the source address home of the service stream.
Source SF	The source SF is an SF to which a certain service stream belongs. It performs stream classification. It may implement a session admission control strategy according to QoS commands.

In respect with some requests, it is necessary to allocate QoS paths from the calling parties to the called parties, and vice versa. In order to accelerate the QoS signalling process, the signalling process for paths in two directions to be allocated for one request may be provided.

7.1 BCF source addressing information flows

In order to hide the network topology of the bearer control layer to the service control layer, the SCF does not need to know where the source BCF for each call is specifically located. The SCF only needs to initiate a request to any BCF and the request will be transferred to the source BCF via the source seeking BCF process, so that a normal process of the request for resources can be started.

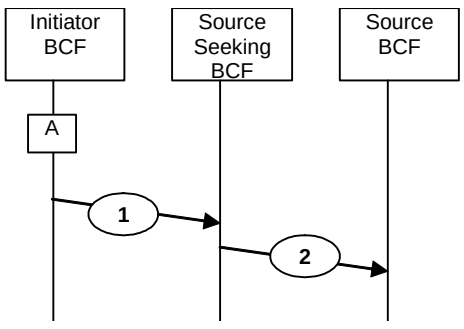

Figure 2: BCF source addressing information flows

The flows illustrated in figure 2 are as follows:

A:

The initiator BCF performs the seeking of the real source BCF. The initiator BCF check whether the source address of stream information in the QoS request received from SCF belongs to the management of the Administrant Domain which the initiator BCF takes charge of. When it finds that the source address of stream information in the QoS request does not belong to its Administrant Domain, it issues information flow 1.

1: IP Setup- Request. ready Initiator BCF to Source Seeking BCF.

Table 2: Information elements for information flow 1

User information	Connection information
IP Streams description information Service type (optional) Gating information	Connection ID Stream information (a set of one or more Address, Protocol and Port Tuples) QoS parameter

Processing upon receipt: The Source Seeking BCF checks whether the source address of stream information in the QoS request belongs to the management of the Administrant Domain which the Source Seeking BCF takes charge of. When it finds that the source address of stream information in the QoS request does not belong to its Administrant Domain, it acts as a Source Seeking BCF. The Source Seeking BCF queries the "Source BCF" route to find out the next hop BCF, to which it will transfer the request. Then it issues information flow 2.

2: IP Setup- Request. ready Source Seeking BCF to Source BCF

User information	Connection information
IP streams description information Service type (optional) Gating information	Connection ID Stream information (a set of one or more Address, Protocol and Port Tuples) QoS parameter

Processing upon receipt: The BCF check whether the source address of stream information in the QoS request belongs to the management of the Administrant Domain which the BCF takes charge of. When it finds that the source address of flow information in the QoS request belongs to its Administrant Domain, the process of addressing source BCF is completed and this BCF acts as a Source BCF.

7.2 Uni-directional QoS path establishment information flows

There are two approaches in the QoS path establishment procedures. The difference is the existence of the provisional response from BCF to SCF, by which the BCF notifies to SCF that the resource allocation is successful, just before confirming the local policies to the corresponding SF. When the SCF receives the provisional response, then it changes the state of the service control from "waiting for the successful completion of resource allocation" to the next state with issuing the awaited service control messages. This approach can be applied when the resource management is integrated with service control in which the completion of the resource allocation is required before the progress and completion of the session establishment. Some VoIP services may require the completion of resource allocation before the called party's state transition into the alerting.

In the following, the scenario when the resource request is processed without the provisional response is called "1-phase case". If the request is processed with this response it is called "2-phase case".

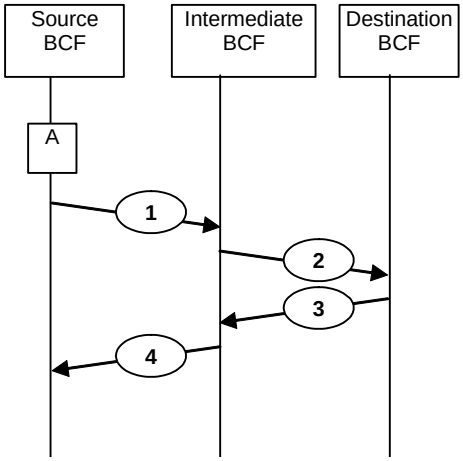

Figure 3: Forward unidirectional QoS path establishment information flows

The flows illustrated in figure 3 are as follows:

A:

The Source BCF (also an initiator BCF) allocates the path resources of the local domain. It then issues information flow 1.

1: IP Setup -Request.ready Source BCF to Intermediate BCF.

User information	Connection information
IP streams description information Service type (optional) Gating information	Connection ID Stream information (a set of one or more Address, Protocol and Port Tuples) QoS parameter Path information selected in the local domain (for the MPLS case) Address information of the inter-domain interface (for the non-MPLS case)

Processing upon receipt: The intermediate BCF allocates the intermediate path resources. It then issues information flow 2.

2: IP Setup -Request.ready Intermediate BCF to destination BCF.

User information	Connection information
IPstreams description information Service type (optional) Gating information	Connection ID Stream information (a set of one or more Address, Protocol and Port Tuples) QoS parameter Path information selected in the local domain and the previous domains (for the MPLS case) Address information of the inter-domain interface (for the non-MPLS case)

Processing upon receipt: The result of the destination BCF route decides the final path resource. The destination BCF responds to the intermediate BCF. It then issues information flow 3.

3: IP Setup -Request.commit destination BCF to Intermediate BCF.

User information	Connection information
IP streams description information Service type (optional) Gating information	Connection ID Accepted QoS parameter Whole Path information (for the MPLS case) Address information of the inter-domain interface (for the non-MPLS case)

Processing upon receipt: The intermediate BCF responds to the source BCF. It then issues information flow 4.

4: IP Setup -Request.commit Intermediate BCF to Source BCF.

User information	Connection information
IP streams description information Service type (optional) Gating information	Connection ID Accepted QoS parameter Whole Path information (for the MPLS case) Address information of the inter-domain interface (for the non-MPLS case)

Processing upon receipt: It then issues information flow to the Source SF or SCF (only for 2-phase case).

7.3 Bidirectional QoS path establishment information flows

There are two methods to establish bidirectional QoS path supporting symmetric QoS requests, one is allocate the path of the two directions at one time, which can be applied in the case that the transport plane has a capability to perform the explicit routing for reducing the time of the signalling procedures (see clause 7.3.1); the other is to use two unidirectional information flows (see clause 7.3.2).

The differences between unified-allocated forward-and-backward-resource information flows and separately-allocated forward-and-backward-resource information flows are:

- Path information of two directions should be needed for the source BCF and intermediate BCF to initiate a resource request. For a bidirectional path with unified-allocated forward-and-backward-resource information flows, both forward and backward paths are needed.
- Path information of two directions should also be needed for the destination BCF and intermediate BCF to initiate a resource response.
- The destination BCF needs to deliver a piece of QoS configuration information from the called to the caller to the destination SF.

7.3.1 Unified-allocated forward-and-backward-resource information flows

NOTE: The flows drawn in dashed lines are used only in the 2-phase case.

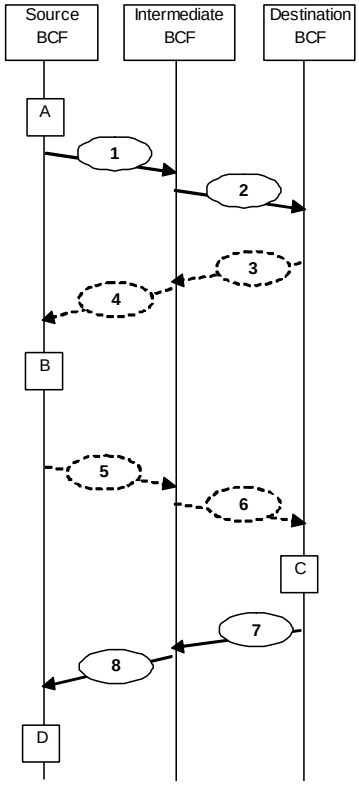

Figure 4: Bidirectional QoS path establishment information flows with unified-allocated signalling path

The flows illustrated in figure 4 are as follows:

A:

The Source BCF allocates the path resources of the local domain. It then issues information flow 1.

1: IP Setup -Request.ready Source BCF to Intermediate BCF.

User information	Connection information
IP streams description information Service type (optional) Gating information	Connection ID Stream information (a set of one or more Address, Protocol and Port Tuples) QoS parameter Path information selected in the local domain (for the MPLS case) Address information of the inter-domain interface (for the non-MPLS case)

Processing upon receipt: The intermediate BCF allocates the intermediate path resources. It then issues information flow 2.

2: IP Setup -Request.ready Intermediate BCF to destination BCF.

User information	Connection information
IP streams description information Service type (optional) Gating information	Connection ID Stream information (a set of one or more Address, Protocol and Port Tuples) QoS parameter Path information selected in the local domain and the previous domains (for the MPLS case) Address information of the inter-domain interface (for the non-MPLS case)

Processing upon receipt: The result of the destination BCF route decides the final path resource. The BCF responds to the intermediate BCF. It then issues information flow 3.

3: IP Setup -Request.commit Destination BCF to Intermediate BCF (only in 2-phase case).

User information	Connection information
IP streams description information Service type (optional) Gating information	Connection ID Accepted QoS parameter Whole Path information (for the MPLS case) Address information of the inter-domain interface (for the non-MPLS case)

Processing upon receipt: The intermediate BCF responds to the source BCF. It then issues information flow 4.

4: IP Setup -Request.commit Intermediate BCF to Source BCF (only in 2-phase case).

User information	Connection information
IP streams description information Service type (optional) Gating information	Connection ID Accepted QoS parameter Whole Path information (for the MPLS case) Address information of the inter-domain interface (for the non-MPLS case)

Processing upon receipt: The source BCF issues information flow to SCF.

B:

In 2-phase case, the Source BCF receives the information flow from SCF and Flow 5 is issued to control the configuration information of the opposite side SF.

5: IP Setup -Request.ready Source BCF to Intermediate BCF (only in 2-phase case).

User information	Connection information
IP streams description information Service type (optional) Gating information	Connection ID Stream information (a set of one or more Address, Protocol and Port Tuples) QoS parameter Whole Path information (for the MPLS case) Address information of the inter-domain interface (for the non-MPLS case)

Processing upon receipt: The intermediate BCF finds out the next hop until the destination BCF. It then issues information flow 6.

6: IP Setup -Request.ready Intermediate BCF to destination BCF (only in 2-phase case).

User information	Connection information
IP streams description information Service type (optional) Gating information	Connection ID Stream information (a set of one or more Address, Protocol and Port Tuples) QoS parameter Whole Path information (for the MPLS case) Address information of the inter-domain interface (for the non-MPLS case)

Processing upon receipt: The destination BCF controls the destination SF for the stream with the direction from the destination SF to the Source SF. Upon getting a piece of complete path resource information, the destination BCF forms a piece of stream QoS configuration information to deliver a piece of configuration information to the destination SF. It then issues information flow to destination SF.

C:

The destination SF installs the configuration information to control the data stream transfer. It then issues information flow back to destination BCF.

7: IP Setup -Request.commit Destination BCF to Intermediate BCF.

User information	Connection information
IP streams description information Service type (optional) Gating information	Connection ID Accepted QoS parameter Whole Path information (for the MPLS case) Address information of the inter-domain interface (for the non-MPLS case)

Processing upon receipt: The intermediate BCF responds to the source BCF. It then issues information flow 8.

8: IP Setup -Request.commit Intermediate BCF to Source BCF.

User information	Connection information
IP streams description information Service type (optional) Gating information	Connection ID Accepted QoS parameter Whole Path information (for the MPLS case) Address information of the inter-domain interface (for the non-MPLS case)

D:

The Source BCF issues information flow to control the stream QoS configuration information of the source SF. For the case that there is no need to wait the whole path information and quick process, After receiving information flow which is the response for "backward message flows" as well as information flow which is the response for "forward message flows" the source and initiator BCF issues information flow sent to SCF.

7.3.2 Separately-allocated forward-and-backward-resource information flows

Figure 5 shows the separately-allocated forward-and-backward-resource information flows. For the backward information flows, if both of calling and called part SCF take part in the procedure, we can use the second figure; if only one of the calling and called part SCF take part in the procedure, we can use the third figure.

In the case of one of the calling and called part SCF taking part in the procedure; this is performed with two parallel unidirectional information flows described in clause 7.2 except the following points:

- The BCF receiving information flow from SCF splits the signalling sequence into two sequences with opposite directions.
  In the 2-phase case, this split is also performed after receiving information flow from SCF.
- The BCF receiving information flow 1 also waits the response of each sequence (information flow from Source SF and S8), and then consolidates these two signalling sequences into a single sequence.
  In the 2-phase case, this consolidation is also performed before issuing information flow to SCF.
- For performing the resource control in the direction where the initiating BCF is not the source BCF, the source BCF seeking flows (described in clause 7.1) are applied as described with information flows (S1, S2, S3, S4, S5, S6, S7, S8).

NOTE: The flows drawn in dashed lines are used only in the 2-phase case.

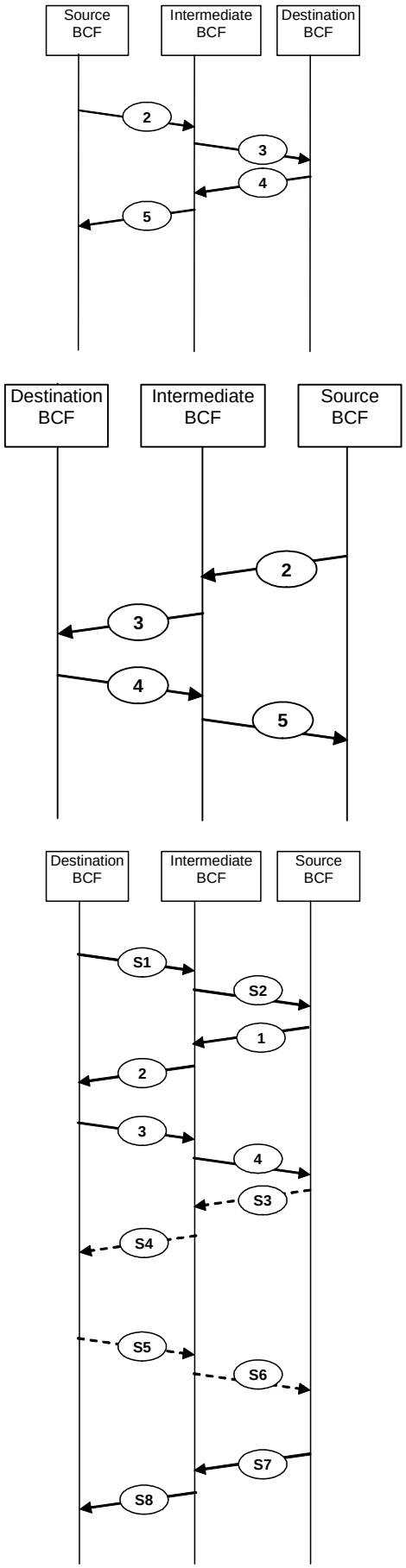

Figure 5: Separately-allocated forward-and-backward-resource information flows

8 The relationship with TISPAN NGN

This clause explains the relationship between the functional entities defined in the RACS document (DES02020) and the functional entities defined in the document: i.e. relationship/mapping between SPDF, A-RACF/RACS and BCF.

Table 3: Mapping of functions

WI2024 BC Entities	WI2020 RACS Entities
SCF	AF
BCF	RACF
	SPDF
SF	BGF
	RCEF
NOTE 1: In the present document, the SF may be BGF or RCEF. As it to say, RCEF and BGF maybe look as the instances of SF.	
NOTE 2: The function of BCF may be decomposed into RACF and SPDF. The decomposition is not restricted in the present document.	

Explanation about the reference point of SCF-BCF, BCF-SF, BCF-BCF:

- The reference point between SCF and BCF may be similar to that between AF and SPDF. But the information exchanged on this reference point maybe a superset of the Gq" for bearer control. Because in fact the behaviour for a system with bearer control may be more complex than what expected about Gq", such as re-routing, crank-back and bypass control.

Refer to note 1 in table 3, the reference point between BCF and SF should be Ia reference point when SF is BGF, and it should be Re reference point when SF is RECF. But some special requirement related to bearer control may be omitted in TISPAN NGN release 1.

The NCI reference point is used to carry bearer requests and responses between BCF(s). Each BCF function may be in a different administrative domain. It is clear that we need to co-ordinate the requested behaviour in the adjacent network and beyond to the behaviour in the domain making the request. Within the Release 1 design there is only limited co-ordination within the RACS at the SPDF. The Bearer Control design will require more co-ordination. It seems perhaps that the more appropriate function in the RACS architecture to be extended for this purpose is the SPDF.

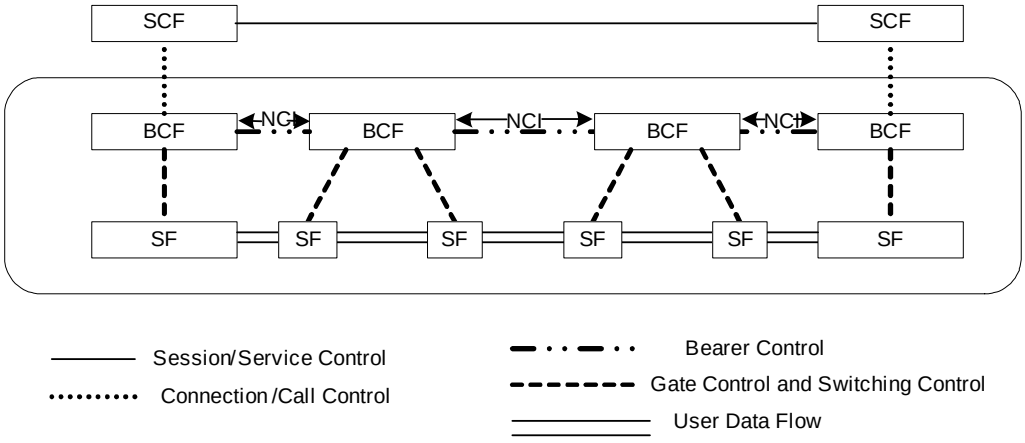

Figure 6: Bearer control architecture

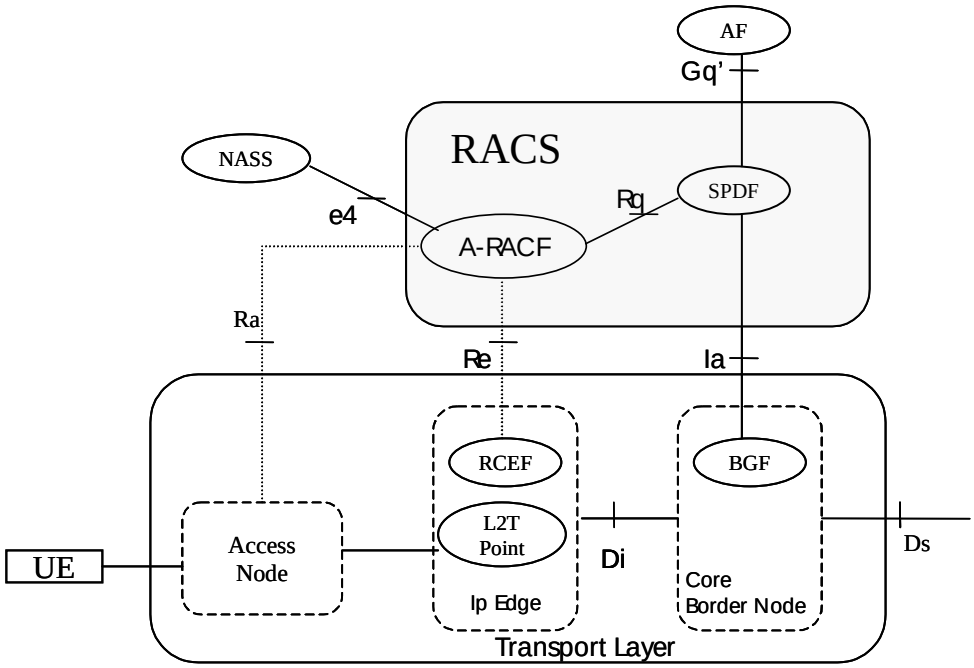

Figure 7: RACS architecture

Annex A (informative): Mapping ITU-T Q.Sup51 into TR-RACF

Figure A.1 shows the mapping of ITU-T Q.Sup51 into the TR-RACF. The end to end architecture shown in figure A.1 shows a possible evolution of the TISPAN architecture. In figure 8 the TISPAN RACS SPDF takes the role of the PDF in figure 8 while the role of the A-TRCF is taken by the A-RACF. Note that Release 1 does not contain the C-TRCF function, hence no End-to-End QoS signalling is part of Release 1.

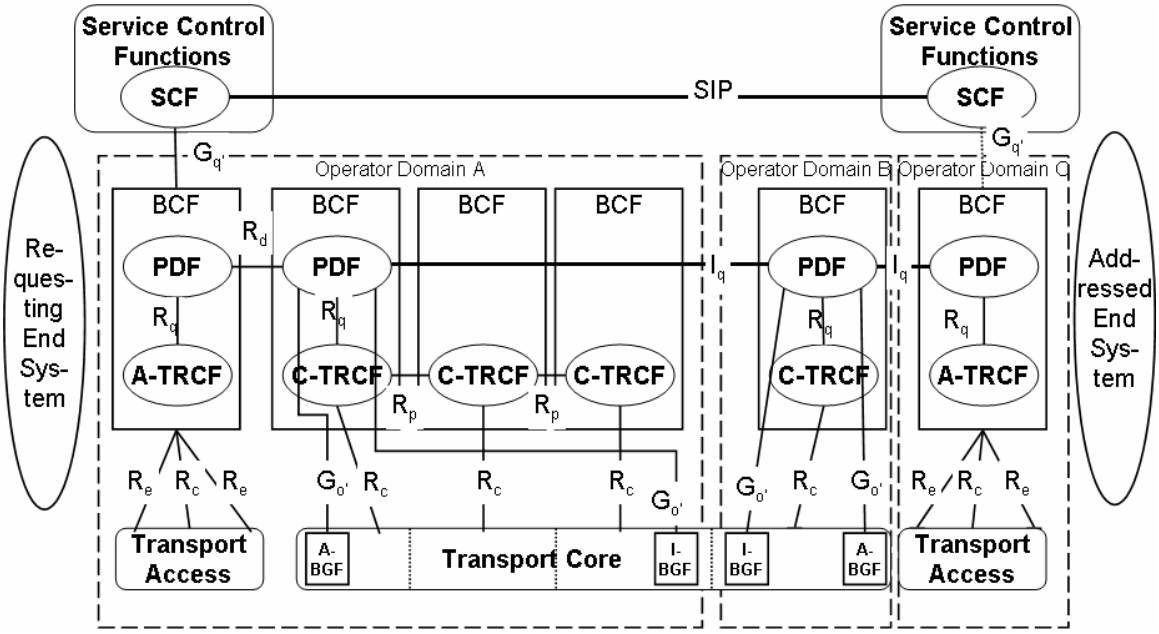

Figure A.1: Mapping ITU-T Q.Sup51 into TR-RACF

History

Document history		
V1.1.1	June 2006	Publication