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SERIES Q: SWITCHING AND SIGNALLING

Signalling requirements and protocols for the NGN – Resource control protocols

Use of the access node control protocol on the Rp interface

Recommendation ITU-T Q.3312

International Telecommunication Union

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Recommendation ITU-T Q.3312

Use of the access node control protocol on the Rp interface

Summary

Recommendation ITU-T Q.3312 describes the use of access node control protocol (ANCP) on the Rp interface. It defines the associated signalling architecture, specifies the signalling flows required to support combined unicast and multicast admission control. It also specifies profiles of the ANCP and resource connection initiation protocol (RCIP), Recommendation ITU-T Q.3322, required for this task. Interworking between RCIP and ANCP is also specified in this Recommendation.

History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T Q.3312	2010-10-14	11

FOREWORD

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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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As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at http://www.itu.int/ITU-T/ipr/.

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Introduction

In some operators' access network deployments, resource and admission control function (RACF) may not have direct access to a particular access node (AN-PE). This is not a problem for policy (which is typically simple and pre-configured by other means). However, it does require additions to the signalling architecture for resource control, as described in this Recommendation.

In the current RACF architecture, the RACF manages the total bandwidth and dynamically assigns portions of bandwidth for unicast and multicast video traffic. In one possible arrangement, the traffic set aside for unicast traffic is managed by a top-tier TRC-PE, while the multicast bandwidth is managed by an instance of the TRC-FE implemented in the access node. As a result, the messaging to the access node passes via the Rp interface. The protocol initially defined for that interface was RCIP [ITU-T Q.3322].

For some access transport technologies, the preferred protocol for control of the access node is the access node control protocol (ANCP). In order to allow use of ANCP at the access node and RCIP at the top-tier TRC-PE, this Recommendation specifies an interworking function within the EN-PE that interworks between the two protocols. It specifies other aspects required to achieve the general goal of coordinated control of admission of unicast flows at the top-tier TRC-PE and of multicast flows at the access node. Such an arrangement minimizes response times for broadcast video channel selection by the user while providing centralized control over bandwidth usage for video on-demand applications.

Recommendation ITU-T Q.3312

Use of the access node control protocol on the Rp interface

1 Scope

This Recommendation describes the use of access node control protocol (ANCP) on the Rp interface. It defines the associated signalling architecture, specifies the signalling flows required to support combined unicast and multicast admission control. It also specifies profiles of the ANCP and resource connection initiation protocol (RCIP) [ITU-T Q.3322] required for this task. Interworking between RCIP and ANCP is also specified in this Recommendation.

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.3322] Recommendation ITU-T Q.3322 (2010), *Resource control protocol no. 2 (rcp2) – Protocol at the Rp interface between transport resource control physical entities*.

[ITU-T Y.2111] Recommendation ITU-T Y.2111 (2008), *Resource and admission control functions in next generation networks*.

3 Definitions

There are no definitions in this Recommendation.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AN Access Node (individual device)

ANCP Access Node Control Protocol

AN-PE Access Node Physical Entity; Physical entity performing the functions of the PE-FE and a collocated instance of the TRC-FE, as defined in [ITU-T Y.2111]

ANX Access Node Complex

BNG Broadband Network Gateway

BRAS Broadband Remote Access Server

CPE Customer Premises Equipment

DSL Digital Subscriber Line

DSLAM Digital Subscriber Line Access Multiplexer

EN-PE Edge Node Physical Entity; a physical entity performing the functions of the EN-FE, as defined in [ITU-T Y.2111], and also implementing an interworking function supporting the compound Rp interface defined in this Recommendation

FTTP	Fibre To The Premises
HGW	Home Gateway
IGMP	Internet Group Management Protocol
IP	Internet Protocol
OLT	Optical Line Termination
ONT	Optical Network Termination
ONU	Optical Network Unit
OSS	Operations Support System
PD-PE	Policy Decision Physical Entity
PON	Passive Optical Network
QoS	Quality of Service
RACF	Resource and Admission Control Function
RCIP	Resource Connection Initiation Protocol; the protocol defined in [ITU-T Q.3322]
TRC-PE	Transport Resource Control Physical Entity; a physical entity implementing the functions of the TRC-FE, as defined in [ITU-T Y.2111]
VDSL	Very high speed Digital Subscriber Line

5 Conventions

There are no specific conventions in this Recommendation.

6 Signalling architecture for joint use of ANCP and RCIP at the Rp interface

The goal of the signalling architecture is to provide a system solution that minimizes response time for broadcast video channel selection by the user while providing centralized control over bandwidth usage for video on-demand applications. The specification of the use of ANCP at the AN-PE and RCIP at the top-tier TRC-PE is a basic assumption of this Recommendation, and is required because of legacy implementation of the AN-PE and TRC-PE alike. Figure 6-1 shows the physical entities and protocols involved. It is assumed that there is a trust relation between the top-tier TRC-PE and the EN-PE, between the EN-PE and the AN-PE, but no possibility for direct signalling between the top-tier TRC-PE and the AN-PE.

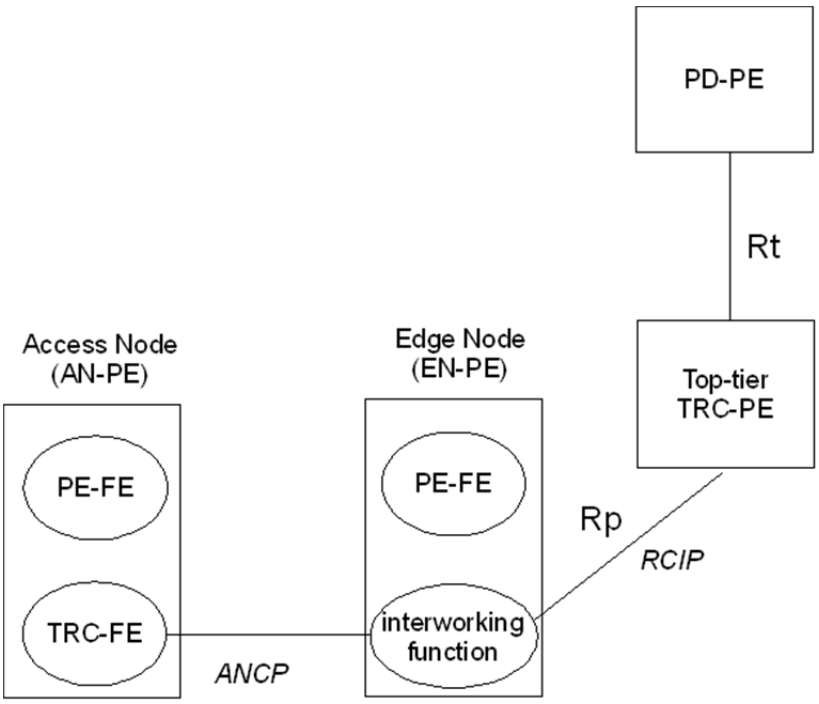


Figure 6-1 – Architecture for joint use of ANCP and RCIP on the Rp interface

6.1 Component functions

The functions of the physical components shown in Figure 6-1 are as follows:

Access node

The AN-PE (e.g., DSLAM, OLT and ONU/ONT) enforces admission control for multicast flows.

The AN-PE is further divided into two types:

Access node (AN): Network device, usually located at a service provider central office or street cabinet that terminates access loop connections from subscribers. When the access loop is a digital subscriber line (DSL), this is often referred to as a DSL access multiplexer (DSLAM).

Access node complex (ANX): The access node is decomposed into two geographically separate devices, the optical line termination (OLT) and optical network unit/optical network termination (ONU/ONT). The general term "access node complex (ANX)" will be used when describing a functionality which does not depend on the physical location but rather on the "black box" behaviour of the combination of OLT and ONU/ONT.

The optical line termination (OLT) is located in the service provider's central office. It terminates and aggregates multiple passive optical networks (PONs) (providing fibre access to multiple premises or neighbourhoods) on the user side, and interfaces with the service element (EN-PE) providing subscriber management. It receives the IGMP join request of the user from the ONT/ONU when the ONT/ONU has admitted the multicast request and determines whether to admit the request. If the request is denied, the OLT will send a notification to the ONT/ONU to indicate the failure to join the multicast group.

The optical network terminal (ONT) terminates PON on the network side and provides PON adaptation. The user side interface and the location of the ONT are dictated by the type of network deployment. For fibre-to-the-premises (FTTP) deployment (with fibre all the way to the apartment or living unit), the ONT has Ethernet connectivity with the home gateway (HGW)/customer premises equipment (CPE). In case of a multi-dwelling or multi-tenant unit, a multi-subscriber ONU typically resides in the basement or a wiring closet, and has Ethernet connectivity with each CPE. In the case where fibre is terminated outside the premises (neighbourhood or curb side) on an

ONT/ONU, the last-leg-premises connections could be via existing or new copper, with xDSL physical layer (typically VDSL). In this case, the access node complex (OLT & ONT together) effectively is a "PON fed DSLAM".

Edge node

Edge node physical entity (EN-PE): The EN-PE is a network element which aggregates subscriber traffic from a number of ANs or ANXs. The EN-PE is often an injection point for policy management and IP QoS in the access network. It is also referred to as broadband network gateway (BNG) or broadband remote access server (BRAS).

The EN-PE provides the following functions:

– Interworking and forwarding the unicast bandwidth request from TRC-PE to AN-PE when the unicast bandwidth available at the TRC-PE is not enough for the new unicast video flows.
– Interworking and forwarding the unicast bandwidth response from AN-PE to TRC-PE indicating whether the unicast bandwidth is allocated successfully for unicast video flows.
– Interworking and forwarding the multicast bandwidth request from AN-PE to TRC-PE when the multicast bandwidth available at the AN-PE is not enough for the new multicast video flows.
– Interworking and forwarding the multicast bandwidth response from TRC-PE to AN-PE indicating whether the multicast bandwidth is allocated successfully for multicast video flows.

Interworking function

The interworking function is within the EN-PE that enables interworking between RCIP and ANCP and has the following characteristics:

• Connecting to the top-tier TRC-PE through the Rp reference point and from the top-tier TRC-PE's point of view, the interworking function is the termination point of the Rp reference point.
• Connecting to the co-located TRC-PE in the access node via ANCP protocol.
• Operating between top-tier TRC-PE and co-located TRC-PE, it proxies Rp messages between EN-PE and AN-PE.

ANCP is used between the EN-PE and AN-PE in the above procedures.

Top-tier TRC-PE

The top-tier TRC-PE exercises admission control for unicast flows. When the unicast bandwidth available at the TRC-PE is not enough to satisfy the unicast request for a new flow, the TRC-PE can query AN-PE directly or via the EN-PE to request the release of some of the multicast delegated to the AN-PE. In the case where the TRC-PE queries AN-PE directly, the use of ANCP is not needed, and thus this case is beyond the scope of this Recommendation. In the case where the TRC-PE queries the AN-PE indirectly via the EN-PE, the use of ANCP is required between the EN-PE and AN-PE. The AN-PE decides if the bandwidth request can be satisfied and sends a response to the TRC-PE via the EN-PE indicating the updated delegated multicast bandwidth.

PD-PE

No new requirement of PD-PE.

7 Protocol profiles

7.1 Specification of ANCP

The access node control protocol (ANCP) is a dedicated control protocol used between the EN-PE and AN-PE to facilitate QoS control in the access network, simplify the operations support system (OSS) infrastructure for service management, optimize multicast replication to enable video services over DSL and PON, support subscriber statistics retrieval on the EN-PE for accounting purposes, and provide fault isolation capability on the EN-PE for the underlying access technology.

This Recommendation requires that the ANCP capability of multicast bandwidth delegation be supported. This implies support of the following ANCP messages and procedures:

– TCP/IP start up
– ANCP Adjacency (synchronization and capability exchange)
– Port Management (line provisioning)
– Delegated Bandwidth Query Request
– Delegated Bandwidth Query Response
– Bandwidth Reallocation Request
– Bandwidth Transfer

7.2 Specification of RCIP

The RCIP protocol is designed to be able to support signalling along a chain of control elements (preconfigured TRC-PEs) in an operator's network for a collection of most commonly used QoS models and requirements, including (but not limited to) traffic specification, priority, MPLS labels and virtual switching connection information. A multimedia service call traversing the network, which comprises one or more sessions (each having application/user-specific QoS specification), will get desired QoS treatment in the data plane (i.e., the chain of T-PEs), through appropriate configuration of the T-PEs by TRC-PEs.

This Recommendation requires that the RCIP capability of line/port provisioning be supported. This implies support of the following RCIP messages and procedures [ITU-T Q.3322]:

– Resource Request (RR) message
– Resource Acceptance (RA) message
– Resource Rejection (REJ) message
– OPEN (OPEN) message
– ACCT (ACCT) message
– CLOSE (CLOSE) message

8 Interworking between ANCP and RCIP

RCIP is used between the TRC-PE and EN-PE to transmit the interworked RCIP equivalent of the following ANCP messages:

– Delegated Bandwidth Query Request
– Delegated Bandwidth Query Response
– Bandwidth Reallocation Request
– Bandwidth Transfer

The contents of the following ANCP messages are optionally supplied from values configured at the EN-PE or alternatively from values conveyed from the TRC-PE in RCIP messages:

– Port Management (Line provisioning): This message may include the total multicast bandwidth available to the AN-PE for admission control at the access port.

9 Procedures

9.1 Multicast admission control

This clause describes two ANCP procedures for the multicast admission control.

9.1.1 Sufficient bandwidth in AN-PE

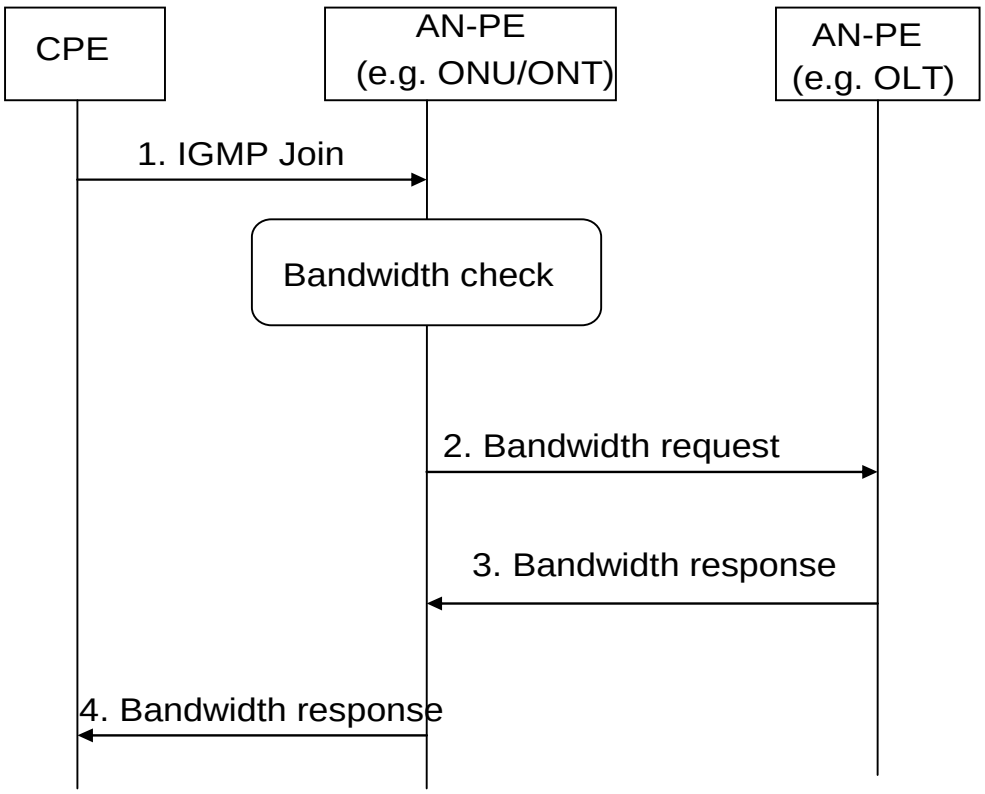


Figure 9-1 – Multicast admission control procedure when there is sufficient bandwidth in AN-PE

1) After receiving the user's IGMP join request for multicast video service, AN-PE determines whether sufficient delegated multicast bandwidth is available for the multicast video request.

2) If the bandwidth is sufficient in AN-PE (e.g., ONU/ONT in the PON case), the multicast video request will be forwarded to the upper level device (e.g., OLT in the PON case) when upper level device exists. The upper level device controls admission for the user's multicast video service. If there is no upper level device, the multicast video request will be admitted.

3) The upper level device will respond to the bandwidth request.

4) The AN-PE will respond to the user's multicast request.

9.1.2 Insufficient bandwidth in AN-PE

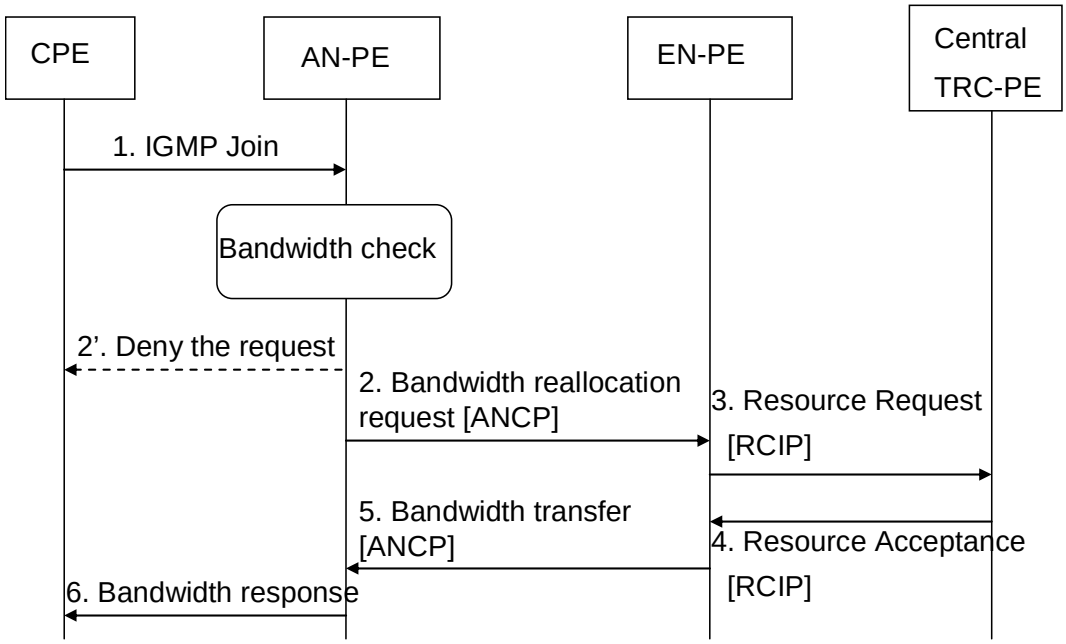


Figure 9-2 – Multicast admission control procedure when there is no sufficient bandwidth in AN-PE

1) The AN-PE receives the user's IGMP join request for multicast video service and checks whether there is sufficient bandwidth.

2') If the bandwidth is not sufficient and cannot be increased, the user's multicast request will be denied. Otherwise,

2) When the bandwidth delegated to the AN-PE is not enough to satisfy the multicast request for a new flow, the AN-PE can query the EN-PE to request additional delegated multicast bandwidth. In this case, the bandwidth reallocation request message is used between AN-PE and EN-PE.

3) The EN-PE sends the resource request message to the central TRC-PE to request additional delegated multicast bandwidth.

4) The central TRC-PE decides if the request for more bandwidth can be satisfied and replies to the EN-PE with the resource acceptance message to indicate the resource request result.

5) The EN-PE sends bandwidth transfer message to the AN-PE indicating the updated delegated multicast bandwidth.

6) The AN-PE will respond to the user's multicast request.

9.2 Unicast admission control

In this case, a subscriber request for a unicast flow (e.g., a video on-demand session) will trigger a resource request message towards the TRC-PE. The TRC-PE determines whether it has enough unicast bandwidth available to honour the request. If not, it may send a resource request to the EN-PE, which interworks the request to a bandwidth reallocation request message and sends it on to the AN-PE. The AN-PE determines how much delegated multicast bandwidth it can release to the TRC-PE, and returns the result in a bandwidth transfer message. The EN-PE interworks this message to a resource response message. Based on the result, the TRC-PE accepts or rejects the request for unicast bandwidth.

10 Security considerations

None.

Appendix I

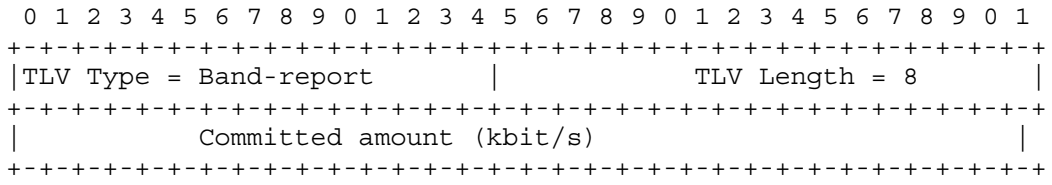
Bandwidth report message

(This appendix does not form an integral part of this Recommendation)

In the procedure when the unicast and multicast resources are adjustable, the co-located TRC-PE (locating in the access node) reports the resource status information to the top-tier TRC-PE. The co-located TRC-PE and top-tier TRC-PE interact with each other to maintain the consistency of the resource status information [ITU-T Y.2111].

A new "bandwidth report message" may be needed in this case in addition to the messages defined in clause 7.2, for co-located TRC-PE reporting the resource status information of the specific network segment to the top-tier TRC-PE.

The bandwidth report message TLV has the format as follows:



The committed amount represents the currently activated multicast bandwidth from the access node's view.

Bibliography

[b-IETF RFC 5851] IETF RFC 5851(2010), *Framework and Requirements for an Access Node Control Mechanism in Broadband Multi-Service Networks*.

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