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Abstract

This memorandum aims at presenting ANCP Multicast handling. It proposes updated description of the Multicast Use cases and corresponding updated ANCP requirements. It also presents the corresponding Message Flows.

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1. Introduction

[I-D.ietf-ancp-framework] defines a framework and requirements for an Access Node Control Mechanism between a Network Access Server (NAS) and an Access Node (e.g. a Digital Subscriber Line Access Multiplexer (DSLAM)) in a multi-service reference architecture in order to perform QoS-related, service-related and Subscriber-related operations. [I-D.ietf-ancp-protocol] specifies a Protocol for Access Node Control Mechanism in Broadband Networks in line with this framework.

[I-D.ietf-ancp-framework] defines multicast use cases (in [section 3.4](#)) as well as the corresponding ANCP Multicast requirements, ANCP Access Node Multicast Requirements and ANCP NAS Multicast Requirements (respectively in sections [4.2](#), [4.7.7](#) and [4.8.6](#)). The multicast use cases addressed are "Conditional Access", "Admission Control", "Accounting and Reporting", and finally "Spontaneous Admission Response". The ANCP requirements associated with the Admission Control use case support a number of models. One such model is where ANCP allows Admission Control to be performed without involvement of the Access Node i.e performed by the NAS (possibly with interactions with a Policy Server). Another model is where Admission Control is to be performed with some involvement of the Access Node i.e. performed by NAS (possibly with interactions with a Policy Server) but this time with some delegation of decision to the Access Node.

This memorandum proposes some enhancements to the ANCP operations for the model where some admission control decision is delegated to the Access Node. The key enhancement is to explicitly delegate multicast bandwidth to the Access Node for the purpose of multicast admission control (instead of simply identifying multicast flows that share the same admission control rules and access control rules, as per current version of [I-D.ietf-ancp-framework]). This allows the Access Node to perform admission control without ANCP signaling with the NAS in more situations than the current proposal.

With this bandwidth delegation approach the AN manages a delegated multicast bandwidth that is a subset of the total video bandwidth for an AN port. The AN can autonomously perform admission control of multicast flows within this delegated bandwidth. An initial value for the delegated multicast bandwidth can be provisioned on the AN by the NAS through ANCP. The AN and NAS then communicate via ANCP to increase or decrease the delegated multicast bandwidth depending on the relative demand of muticast flows versus unicast flows. The proposed approach for admission control with bandwidth delegation is compatible with all the conditional access methods supported by [I-D.ietf-ancp-framework]. In particular, it allows multicast

admission control check to be performed by the AN even when the AN needs to query the NAS for conditional access check.

This memorandum identifies all the corresponding changes that would be required to [[I-D.ietf-ancp-framework](#)] in order to reflect the proposed multicast admission control enhancement. The corresponding message flows are also documented, in view of clarifying all the proposed multicast ANCP operations and facilitating future specification of the corresponding ANCP protocol extensions.

This memorandum does not propose any change to the other model of operations for multicast Admission Control Control, nor to ANCP operations for the other multicast use cases.

2. Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC 2119](#).

3. Multicast Use Cases

This section describes the ANCP use cases related to Multicast.

3.1. Conditional Access

This section discusses the changes proposed to section 3.4.1 of [\[I-D.ietf-ancp-framework\]](#).

[I-D.ietf-ancp-framework] defines the concept of multicast flows that share the same control rules (ie same Conditional Access rules and same Admission Control rules). The objective of this concept was to achieve a tradeoff between pre-provisioning the AN with all Conditional Access and Admission Control information and querying the NAS on a per join basis. The former may be a configuration burden and may lead in large delays when the NAS or AN restarts, while the latter may increase channel join and channel change times because of the additional message processing involved in the AN, the NAS and potentially the Policy Server.

Now considering that

- o this memorandum proposes (in [Section 3.2](#)) the extension of the concept of multicast flows that share the same Admission Control rules into an approach of bandwidth delegation from NAS to the AN whereby channels of equivalent bandwidth no longer need to be provisioned into the AN by the NAS
- o grey lists in case of the Conditional Access scenario are mainly used in order to be able to have the conditional access decision taken by the NAS or a Policy Server (especially in order to address the case when conditional access information changes frequently, or when the multicast groups are not known to a client application in advance, thus where it may not be possible or convenient to pre-provisioning AN with conditional access information)

we propose to simplify operations of Conditional Access and remove the notion of multicast flows sharing the same conditional access rules. Specifically, we propose to remove the following two paragraphs of [section 3.4.1 \[I-D.ietf-ancp-framework\]](#):

"Querying the NAS before performing a join on the AN may increase channel join and channel change times because of the additional message processing involved in the AN, the NAS and potentially the Policy Server. On the other hand, pre-provisioning per subscriber profiles potentially different for each subscriber may be a configuration burden, may result in large delays when the NAS or AN

restarts, or may not be viable when conditional access changes frequently or are to remain under the control of an external administrative entity.

In order to account for these operational factors and associated trade-offs, in some cases, the provisioning and querying techniques can be combined. In such a model, the AN sends an Admission Request message to the NAS as a trigger for a particular multicast flow. The NAS would then send back an Admission Response message to the AN, including conditional access information for that multicast flow, as well as for a set of multicast flows sharing the same conditional access rules. The AN can then autonomously honor or deny requests for a given user/port for the set of Multicast flows as indicated in the Admission Response message."

3.2. Multicast Admission Control

Section 3.4.2 of [[I-D.ietf-ancp-framework](#)] presents the requirement for synchronization between the entity performing multicast CAC, the entity performing unicast CAC and the entity actually enforcing multicast replication. It describes three approaches to perform this synchronization. This memorandum proposes the following changes to the methods described in the first and in the third bullet.

Replace the following text:

" One approach is for the AN to query the NAS so that both unicast and multicast CAC for the access line are performed by the NAS. In this case, the AN can use ANCP to query the NAS, that in turn performs multicast CAC and responds to the AN indicating whether the join is to be honored (and hence replication performed by the AN) or denied. The NAS may locally maintain available "video" bandwidth on the Access Loop, and perform video bandwidth accounting for the Access Loop. Upon receiving an Admission Request from the AN, the NAS can check available "video" bandwidth before admitting or denying the multicast flow. In the process, the NAS may communicate with the Policy Server. For unicast video services such as Video on Demand (VoD), the NAS may also be queried (by a Policy Server or via on-path CAC signaling), so that it can perform admission control for the unicast flow, and update the available video bandwidth maintained by the NAS. Similarly to what has been discussed in the Conditional Access use case, in response to a Admission Request from the AN for admission control of a multicast flow, the NAS may send back an Admission Response message to the AN, including admission control information for that multicast flow, as well as for a set of multicast flows sharing the same admission control rules. The AN can then autonomously honor or deny requests for a given user/port for the set of Multicast flows as indicated in the Admission Response

message. The ANCP requirements to support this approach (where the AN queries the NAS) are specified in this document;"

by the following text:

"One approach is where ANCP allows Admission Control to be performed by the NAS (possibly with interactions with a Policy Server) either without any involvement of the Access Node or with some involvement of the Access Node in particular with the delegation of some decisions to the Access Node.

The NAS uses ANCP to indicate to the AN whether or not Admission Control is needed for each multicast flow on a given Access Port, and where Admission Control is needed whether or not it is to be performed with AN Bandwidth Delegation. In particular:

- o multicast flows that require Admission Control without AN Bandwidth Delegation are inserted in the Grey List and these entries are flagged as "no Bandwidth Delegation";
- o multicast flows that require Admission Control with AN Bandwidth Delegation are:
 - o
 - * inserted in the White list and flagged as "Bandwidth Delegation", in case they do not require any Conditional Access operation to be performed by the NAS
 - * inserted in the Grey List and flagged as "Bandwidth Delegation", in case they require some Conditional Access checks to be performed by the NAS.

In case of Admission Control without AN Bandwidth Delegation, the AN can use ANCP to query the NAS, that in turn performs multicast Admission Control check for the new multicast flow and responds to the AN indicating whether the join is to be honored (and hence replication performed by the AN) or denied. The NAS may locally maintain available "video" bandwidth on the Access Loop, and perform video bandwidth accounting for the Access Loop. Upon receiving an Admission Request from the AN, the NAS can check available "video" bandwidth before admitting or denying the multicast flow. In the process, the NAS may communicate with the Policy Server. For unicast video services such as Video on Demand (VoD), the NAS may also be queried (by a Policy Server or via on-path CAC signaling), so that it can perform admission control for the unicast flow, and update the available video bandwidth maintained by the NAS.

In case of Admission Control with AN Bandwidth Delegation, the NAS (possibly with interactions with a Policy Server) manages total bandwidth for video admission, performs unicast admission control and uses ANCP to delegate a certain amount of bandwidth for some multicast flows to the Access Node. In this scenario upon receiving a join to a multicast flow which matches the White or Grey Lists whose entry is flagged as "Bandwidth Delegation" for a specific Access Port, before starting the multicast flow replication the AN must perform the necessary bandwidth admission control check for the new multicast flow.

In some cases, the bandwidth that the NAS initially delegated to the AN may not be enough to satisfy a multicast request for a new flow. In this scenario the AN can use ANCP to query the NAS in order to request additional multicast bandwidth; the NAS (possibly with interactions with a Policy Server) decides if the request for more bandwidth can be satisfied and uses ANCP to send a response to the AN indicating the updated delegated multicast bandwidth. It is worth noticing that in this case, the time taken to complete the procedure is an increment to the zapping delay: in order to minimize the zapping delay for future join requests the AN can insert in the request message two values: the minimum amount of additional multicast bandwidth requested, and the preferred additional amount. The first value is the amount that allows the present join request to be satisfied, the second value an amount that anticipates further join requests.

In some cases, the NAS (or the Policy Server) may not have enough unicast bandwidth to satisfy a new incoming video request: in these scenarios the NAS can use ANCP to query (or instruct) the AN in order to decrease the amount of multicast bandwidth previously delegated on a given Access Port. The AN upon receiving this query from the NAS can use ANCP to send a response to AN indicating the updated delegated multicast bandwidth. Actually, based on considerations similar to those of the previous paragraph, it indicates the minimum amount of multicast bandwidth that it needs released and a preferred amount, which may be larger.

In addition in some cases upon receiving a leave for a specific multicast flow the AN can decide that it has an excess of delegated but uncommitted bandwidth, thus the AN can use ANCP to send a message to the NAS to release unused multicast bandwidth previously delegated.

The ANCP requirements to support this approach (where the AN queries the NAS) are specified in this document; "

Replace this text:

" In a third approach, the Policy Server queries the AN (either directly, or indirectly via the NAS) so that both unicast and multicast CAC for the access line are performed by the AN. In this case, a subscriber request for a unicast flow (e.g. a Video on Demand session) will trigger a resource request message towards a Policy Server; the latter will then query the AN, that in turn will perform unicast CAC for the access line and respond, indicating whether the unicast request is to be honored or denied. This method will not be addressed in this document; it may be covered by means of ANCP extensions at a later stage. "

by the following text:

"In a third approach, the Policy Server queries the AN directly so that both unicast and multicast CAC for the access line are performed by the AN. In this case, a subscriber request for a unicast flow (e.g. a Video on Demand session) will trigger a resource request message towards a Policy Server; the latter will then query the AN, that in turn will perform unicast CAC for the access line and respond, indicating whether the unicast request is to be honored or denied. In this scenario the Policy Server queries the AN directly, the approach doesn't require the use of ANCP. It is therefore beyond the scope of this document."

3.2.1. When not to perform Admission Control for a subset of flows

This memorandum does not propose any update over the description of this use case provided in section 3.4.2.1 of [[I-D.ietf-ancp-framework](#)].

3.2.2. Multicast Admission Control and White Lists

This memorandum does not propose any update over the description of this use case provided in section 3.4.2.2 of [[I-D.ietf-ancp-framework](#)].

3.3. Multicast Accounting and Reporting

This memorandum does not propose any update over the description of this use case provided in section 3.4.3 of [[I-D.ietf-ancp-framework](#)].

3.4. Spontaneous Admission Response

This memorandum does not propose any update over the description of this use case provided in section 3.4.4 of [[I-D.ietf-ancp-framework](#)].

4. Multicast Protocol Requirements

4.1. ANCP Multicast Requirements

This memorandum proposes the following changes to section 4.2 of [\[I-D.ietf-ancp-framework\]](#).

Replace the following requirement:

- o The ANCP must allow the NAS, when replying to an AN request, to convey information on multiple multicast flows sharing the same conditional access and/or admission control rules. This allows the AN to take autonomous decisions for these flows later on.

by the following requirements:

- o The ANCP must allow the NAS to indicate to the AN whether or not Admission Control is needed for some multicast flows on a given Access Port and where needed whether or not it is to be performed with AN Bandwidth Delegation.
- o In case of Admission Control without AN Bandwidth Delegation the ANCP must allow the NAS to reply to a query from the AN indicating whether or not a multicast flow may be replicated to a particular Access Port.
- o In case of Admission Control with AN Bandwidth Delegation, the ANCP must allow the NAS to delegate a certain amount of bandwidth to the AN for a given Access Port.
- o In case of Admission Control with AN Bandwidth Delegation the ANCP must allow the AN to query the NAS to request additional multicast bandwidth on a given Access Port.
- o In case of Admission Control with AN Bandwidth Delegation the ANCP must allow the NAS to query (or to instruct) the AN to reduce the amount of bandwidth previously delegated on a given Access Port.
- o In case of Admission Control with AN Bandwidth Delegation the ANCP must allow the AN to autonomously release redundant multicast bandwidth on a given Access Port.

4.2. ANCP Access Node Multicast Requirements

This memorandum proposes the following changes to section 4.7.6 of [\[I-D.ietf-ancp-framework\]](#).

Replace the following requirements:

- o The AN must accept any join to a multicast flow matching the White List for the relevant Access Port.
- o Upon receiving a join to a multicast flow which matches the Grey List for a specific Access Port, the AN must support using ANCP to query the NAS to receive a response indicating whether that join is to be honored or denied.
- o Upon querying the NAS, the AN should support receiving ANCP messages from the NAS containing conditional access and/or admission control information of multiple multicast flows. This allows the AN to take autonomous decisions for these flows later on.
- o The AN should support using ANCP to notify the NAS when resources for a multicast flow are no longer in use (e.g. the AN is no longer replicating any multicast flows from a set of multicast flows sharing the same admission control rules). This allows corresponding bandwidth to be released on NAS.

by the following requirements:

- o The AN must accept any join to a multicast flow matching the White List and flagged as "no CAC" for the relevant Access Port.
- o Upon receiving a join to a multicast flow which matches the White List whose entry is flagged as "Bandwidth Delegation" for a specific Access Port, before starting the multicast flow replication the AN must perform the necessary bandwidth admission control check for the new flow.
- o Upon receiving a join to a multicast flow which matches the Grey List whose entry is flagged as "no Bandwidth Delegation" for a specific Access Port, the AN must support using ANCP to query the NAS that in turn will perform both the necessary conditional access and the admission control checks for the new flow and sends a response indicating whether that join is to be honored or denied. The AN must support using ANCP to notify the NAS when the user leaves the multicast flow.
- o Upon receiving a join to a multicast flow which matches the Grey List whose entry is flagged as "Bandwidth Delegation" for a specific Access Port, the AN must perform the necessary bandwidth admission control check for the new flow and if it is successful the AN must support using ANCP to query the NAS to receive a response indicating whether that join is to be honored or denied.

- o In case of Admission Control with AN Bandwidth Delegation, the AN must support using ANCP to query the NAS to request additional delegated multicast bandwidth on a given Access Port; the AN should be able to specify both the minimum and the preferred amount of additional multicast bandwidth requested.
- o In case of Admission Control with AN Bandwidth Delegation, upon receiving a Bandwidth Delegation Request from the NAS querying or instructing to decrease the delegated multicast bandwidth on a given Access Port, the AN must support using ANCP to send a Bandwidth Delegation Response indicating the new delegating multicast bandwidth
- o In case of Admission Control with AN Bandwidth Delegation, the AN must support using ANCP to send a Bandwidth Release message to the NAS in order to release unused delegated multicast bandwidth on a given Access Port.

4.3. ANCP NAS Multicast Requirements

This memorandum proposes the following changes to section 4.8.6 of [[I-D.ietf-ancp-framework](#)].

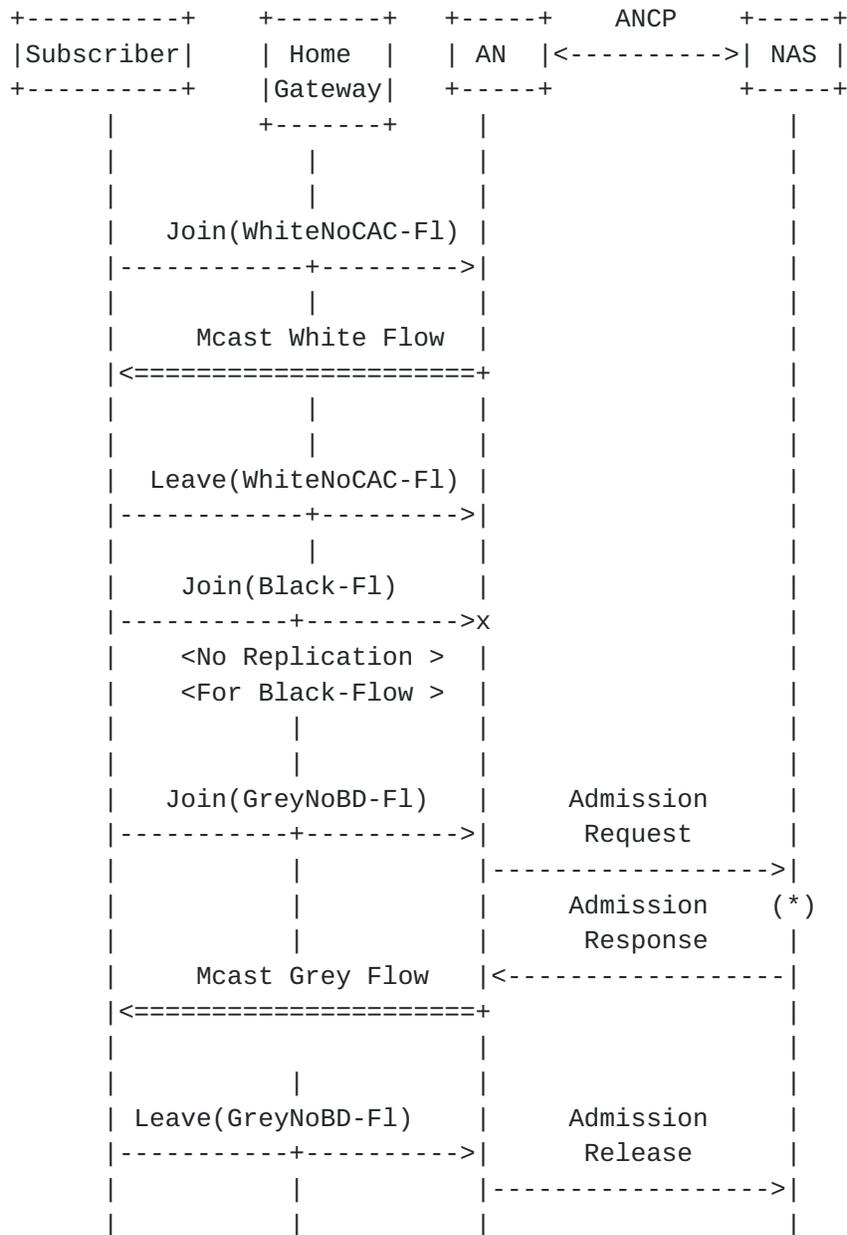
Replace the following requirements:

- o The NAS must support using ANCP to configure multicast conditional access information to Access Ports on an Access Node, using Black Lists and White Lists
- o Upon receiving a query from the AN for a request to replicate a multicast flow to a particular Access Port, the NAS must support using ANCP to reply to the AN indicating whether the request is to be honored or denied.
- o Upon receiving a query from the AN for a request to replicate multicast flow to a particular Access Port, the NAS should support sending an Admission Response message containing conditional access and/or admission control information of multiple multicast flows. This allows the AN to take autonomous decisions for these flows later on

by the following requirements:

- o The NAS must support using ANCP to configure multicast conditional access information to Access Ports on an Access Node, using Black Lists, Grey Lists and White Lists.

- o The NAS must support using ANCP to indicate to the AN whether or not Admission Control is needed for some multicast flows on a given Access Port and where needed whether or not it is to be performed with AN Bandwidth Delegation.
- o Upon receiving a query from the AN for a request to replicate a multicast flow to a particular Access Port and where Admission Control is not needed for that multicast flow on that Access Port, the NAS must be able to perform the necessary conditional access check for the new flow and the NAS must support using ANCP to reply to the AN indicating whether the request is to be honored or denied.
- o Upon receiving a query from the AN for a request to replicate a multicast flow to a particular Access Port and where Admission Control without AN Bandwidth Delegation is needed for that multicast flow on that Access Port, the NAS must be able to perform both the necessary conditional access (if needed) and the bandwidth admission control check for the new flow and the NAS must support using ANCP to reply to the AN indicating whether the request is to be honored or denied.
- o In case of Admission Control with AN Bandwidth Delegation the NAS must support using ANCP to delegate a certain amount of bandwidth to the AN for a given Access Port.
- o In case of Admission Control with AN Bandwidth Delegation, upon receiving a Bandwidth Delegation Request from the AN requesting to increase the delegated multicast bandwidth on a given Access Port, the NAS must support using ANCP to send a Bandwidth Delegation Response indicating the new delegating multicast bandwidth.
- o In case of Admission Control with AN Bandwidth Delegation, the NAS must support using ANCP to send a request the AN to decrease the amount of multicast bandwidth previously delegated on a given Access Port; the NAS should be able to specify both the minimum and the preferred amount decrement of multicast bandwidth requested.
- o In case of Admission Control with AN Bandwidth Delegation, upon receiving an ANCP Bandwidth Release message, the NAS must be able to update accordingly its view of the multicast bandwidth delegated to the AN.



WhiteNoCAC-F1 : Multicast Flow matching an entry in White List
 flagged as "No CAC"

GreyNoBD-F1 : Multicast Flow matching an entry in Grey List
 flagged as "No Bandwidth Delegation"

(*) The NAS may optionnaly communicate with an external
 Authorization/Policy Server

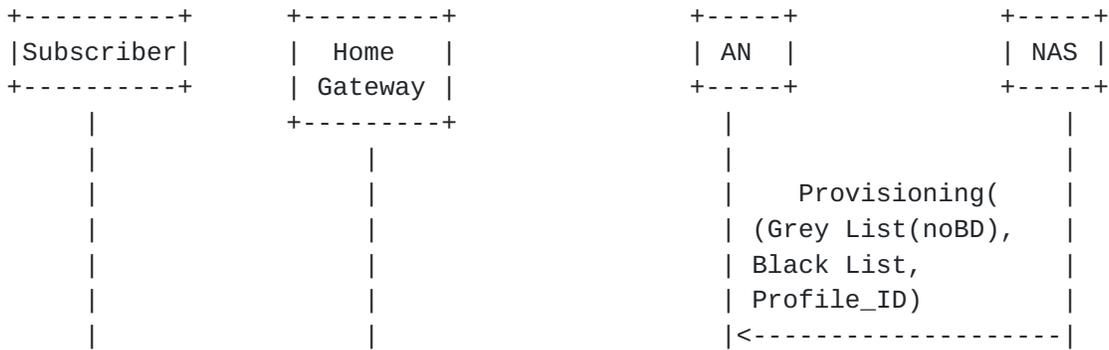
Figure 3: Multicast Conditional Access

5.2. Multicast Conditional Access and CAC without AN Bandwidth Delegation

This section describes ANCP operations when multicast flows are subject to multicast Conditional Access and subject to CAC on NAS without bandwidth delegation on the Access Node.

5.2.1. List/Profile Provisioning

The AN provisioning is performed by NAS using a Provisioning message that contains Black/Grey lists and their corresponding "Multicast Profile ID". To indicate to the AN that it need not perform any CAC operation on those flows, the Grey List entries are flagged as "no Bandwidth Delegation". The corresponding message flow is illustrated in Figure 4.



(noBD) : entries in the Grey List flagged as "no Bandwidth Delegation"

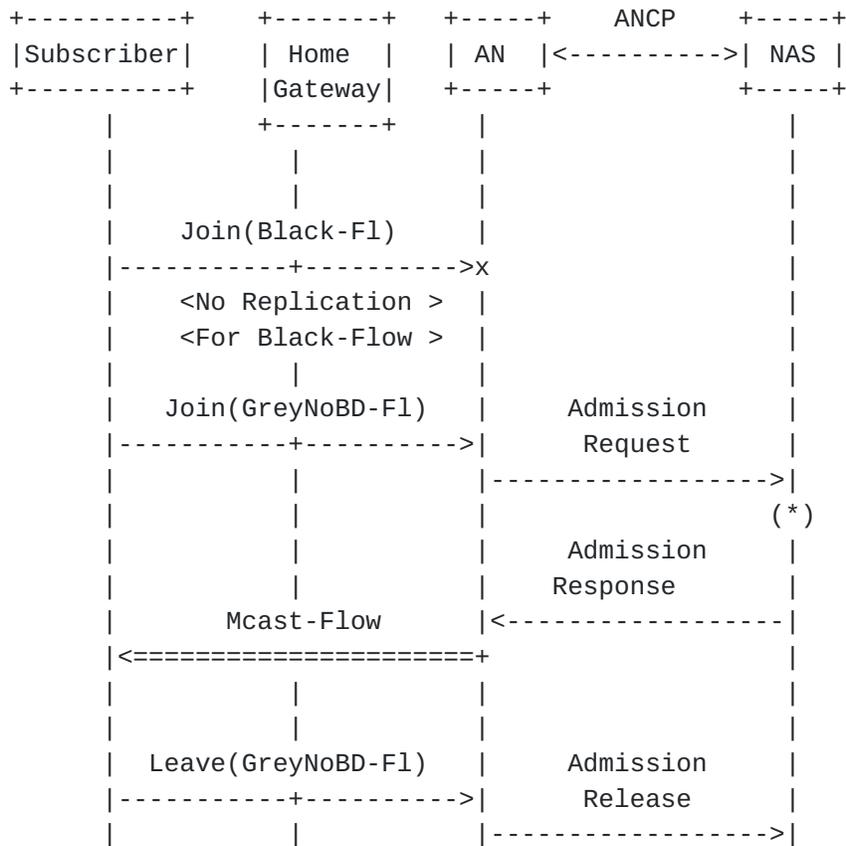
Figure 4: Provisioning AN with Grey/Black Lists for Conditional Access and CAC without Bandwidth Delegation

5.2.2. Profile Mapping

The "Profile ID" is associated to the port when the DSL line comes up in the exact same way as illustrated in Figure 2.

5.2.3. Join & Leave Operations

Upon receiving a join request for a multicast flow in a Grey List whose entry is flagged as "No Bandwidth Delegation", the AN uses ANCP to query the NAS, that in turn will perform the necessary conditional access check and bandwidth admission control check for the new flow and then it will respond to the AN indicating whether the join is to be honored (and hence replication performed by the AN) or denied (and hence replication not performed by the AN). This is illustrated in Figure 5.



(*) The NAS may optionnaly communicate with an external Autorization/Policy Server

Figure 5: Multicast Admission Control without AN Bandwidth Delegation

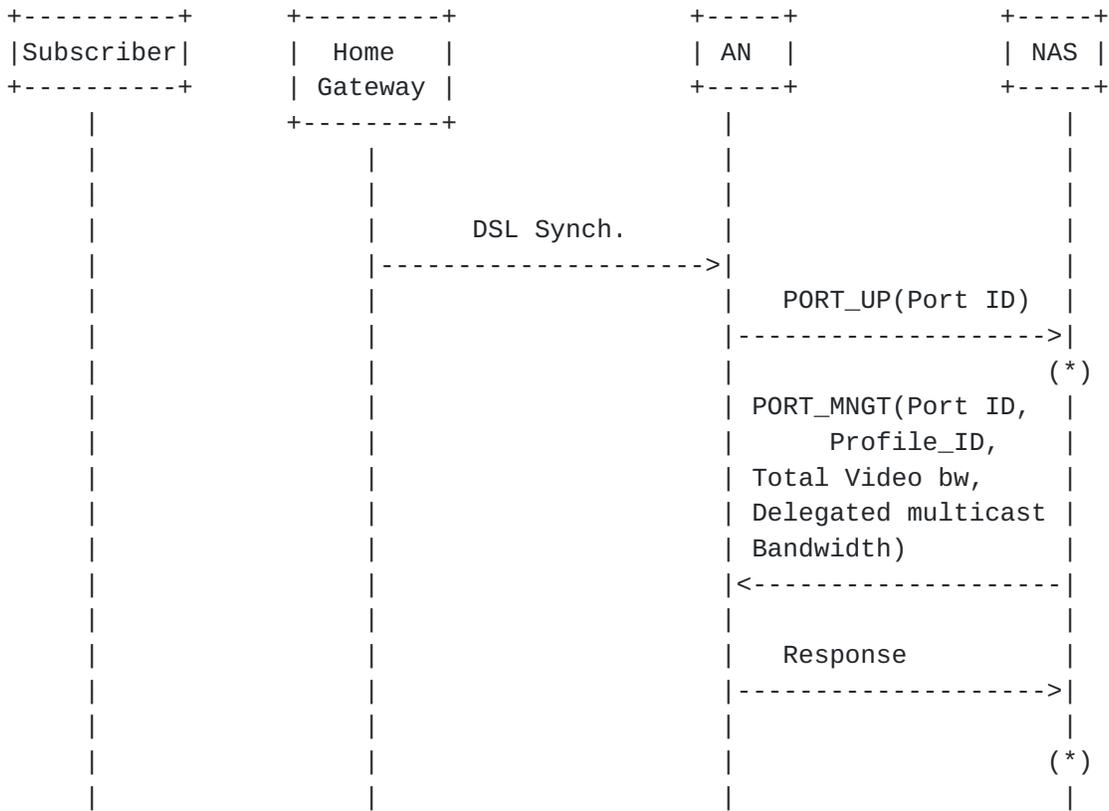
5.3. Multicast Admission Control with AN Bandwidth Delegation

This section describes ANCP operations when multicast flows are subject to multicast Conditional Access and subject to CAC on NAS with bandwidth delegation on the Access Node.

5.3.1. List/Profile Provisioning

The AN provisioning is performed by NAS using a Provisioning message that contains White/Black/Grey lists and their corresponding "Multicast Profile ID". To indicate to the AN that it need perform CAC in compliance with Bandwidth Delegation on those flows, the White List entries and Grey List Entries are flagged as "Bandwidth Delegation". The corresponding message flow is illustrated in Figure 1.

Although Figure 6 shows the three lists in the ANCP provisioning message, the message may instead contain any subset of 2 or 1 list.

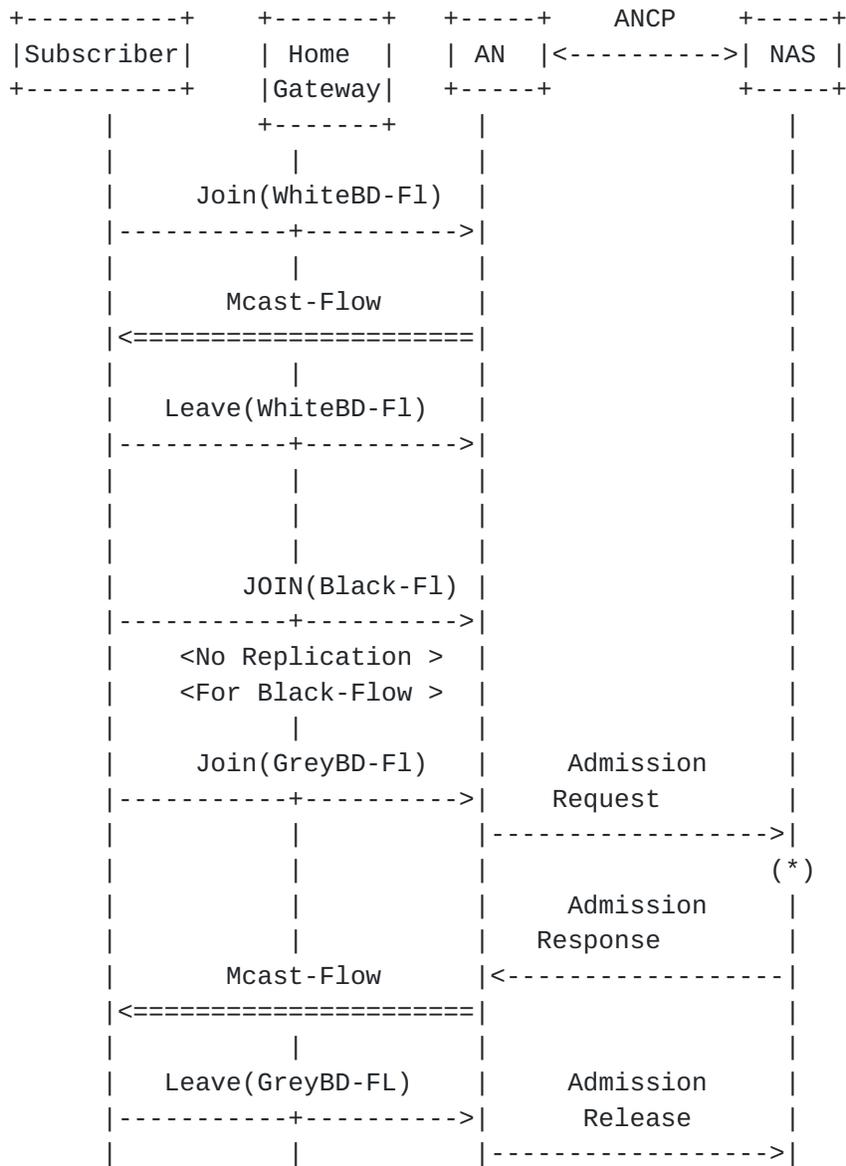


(*) The NAS may optionally communicate with an external Policy Server

Figure 7: Multicast Admission Control with AN Bandwidth Delegation

5.3.3. Join & Leave Operations

Upon receiving a join request for a multicast flow in a Grey List whose entry is flagged as "Bandwidth Delegation", the AN performs admission control of the flow in accordance with Bandwidth Delegation and uses ANCP to query the NAS that in turn will perform the necessary conditional access check for the new flow. The NAS will respond to the AN indicating whether the join is to be honored (and hence replication performed by the AN) or denied (and hence replication not performed by the AN). This is illustrated in Figure 8. In the case where the NAS response indicates that the replication is not to be honored, the AN will reflect this in his Bandwidth Delegation operation (ie release corresponding bandwidth within the delegated bandwidth).

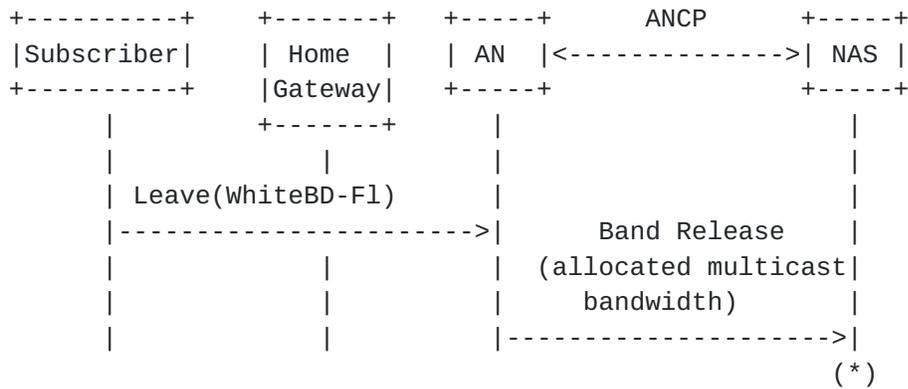


WhiteBD-F1 : Multicast Flow matching an entry in White List
flagged as "Bandwidth Delegation"

GreyBD-F1 : Multicast Flow matching an entry in Grey List
flagged as "Bandwidth Delegation"

(*) The NAS may optionnaly communicate with an
external Autorization/Policy Server

Figure 8: Multicast Admission Control with AN Bandwidth Delegation



WhiteBD-Fl : Multicast Flow matching an entry in White List
 flagged as "Bandwidth Delegation"

(*) The NAS may optionnaly communicate with an
 external Autorization/Policy Server

Figure 11: AN Autonomous Release of Multicast Bandwidth

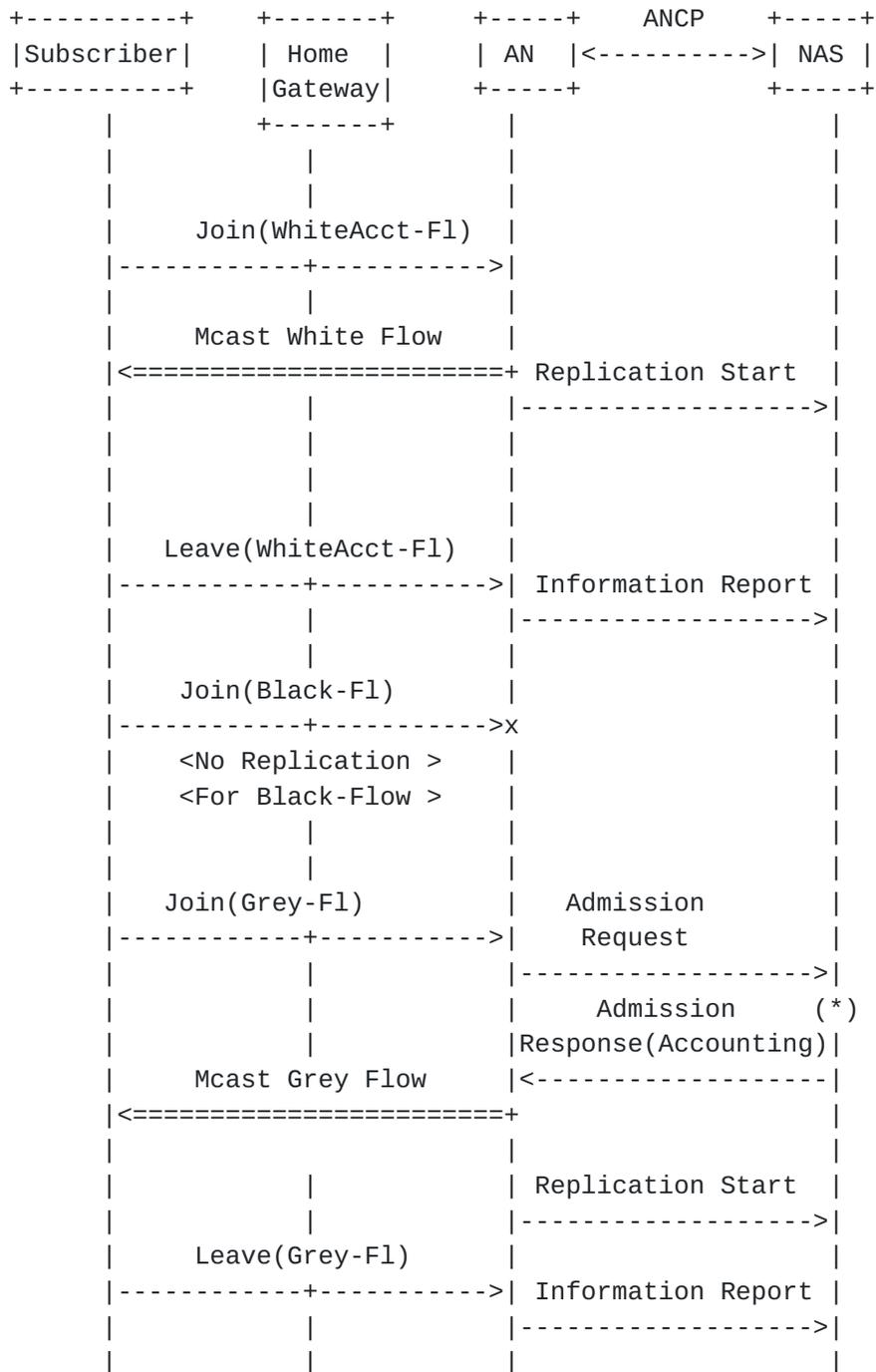
5.4. Multicast Accounting

The NAS specifies if accounting is needed for a particular multicast flow: for Multicast flows belonging to the Grey list this can be conveyed in the ANCP Admission Response message sent from NAS to AN. For Multicast flows whose replication is controlled by the AN via the White list, the AN starts the multicast replication without querying the NAS and thus the NAS does not send Admission Response message; in this case the need for accounting is conveyed by the NAS in the White list during the White list provisioning phase.

5.4.1. List/Profile Provisioning

The AN provisioning is performed by NAS using a Provisioning message that contains White/Black/Grey lists and their corresponding "Multicast Profile ID". To indicate to the AN that it need perform Accounting on those flows, the White List entries are flagged as either "Basic Accounting" or "Detailed Accounting". The corresponding message flow is illustrated in Figure 12.

Although Figure 6 shows the three lists in the ANCP provisioning message, the message may instead contain any subset of 2 or 1 list.



WhiteAcct-Fl : Multicast Flow matching an entry in White List
flagged as "Basic Accounting"

Grey-Fl : Multicast Flow matching an entry in Grey List

(*) The NAS may optionnaly communicate with an external
AAA Server

Figure 13: Multicast Accounting

5.5. Multicast Reporting

NAS uses "Port Report-Query" to query the AN to know which flows are currently active on a specific port;

NAS uses "Multicast Flow Report-Query" to query the AN to know on which ports the specified multicast flow is currently active;

NAS uses "AN global Report-Query" to query the AN to know all multicast flows currently active on all AN ports.

The message flows in Figure 14 illustrates the behavior of the AN in case of receiving one of three Report Query messages from the NAS.

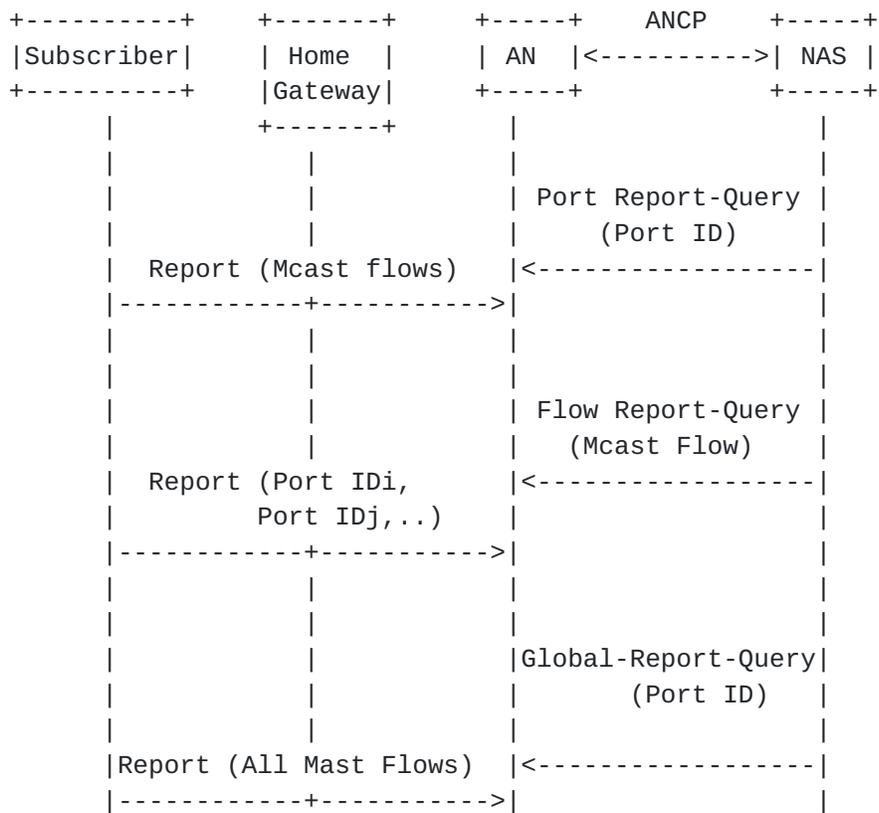


Figure 14: Multicast Reporting

5.6. NAS-Controlled Multicast Replication

The Replication Control Request Message is sent by the NAS to the AN with a directive to either join or leave one or more multicast flows. The AN will use a Replication Control Response message when conveying

6. Security Considerations

Those are addressed in [[I-D.ietf-ancp-framework](#)].

[7.](#) IANA Considerations

Not applicable.

8. Acknowledgements

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9. References

9.1. Normative References

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