ETSI

ETSI TECHNICAL REPORT

ETR 360

May 1997

Source: ETSI TC-NA

Reference: DTR/NA-052111

ICS: 33.020

Key words: B-ISDN, ATM, multipoint

Broadband Integrated Services Digital Network (B-ISDN); Support of multipoint communications in Asynchronous Transfer Mode (ATM) networks

ETSI

European Telecommunications Standards Institute

ETSI Secretariat

Postal address: F-06921 Sophia Antipolis CEDEX - FRANCE
Office address: 650 Route des Lucioles - Sophia Antipolis - Valbonne - FRANCE
X.400: c=fr, a=atlas, p=etsi, s=secretariat - **Internet:** secretariat@etsi.fr

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

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Foreword

This ETSI Technical Report (ETR) has been produced by the Network Aspects (NA) Technical Committee of the European Telecommunications Standards Institute (ETSI).

Introduction

The broadband networks can support a wide variety of services, such as conversational, distributive and broadcast. Some services require from the network the possibility of handling point-to-multipoint or multipoint-to-multipoint communications.

Point-to-point connections are currently offered by networks for communications between two users or between a user and a server. If more than two users are involved in a communication, additional network capabilities are needed. These capabilities could be new types of connections or high layer functions located in a specific equipment.

For example, a **point-to-multipoint communication** can be supported within the network by different means:

- use **point-to-point connections** at the Asynchronous Transfer Mode (ATM) layer associated with multipoint device for the management of all the point-to-point connections involved in the communication. This device could be a server;

- use of **point-to-multipoint connection** at the ATM layer. For this, ATM switching elements should possess built-in multicast functionalities at the ATM layer: the switch duplicates (or copies) the ATM cells of an incoming stream towards all the outgoing Virtual Path/Virtual Circuit (VP/VC) links involved in the point-to-multipoint connection. This functionality could be implemented in different ways in a switch.

Like the duplication functionality, merging functionality when implemented at the ATM layer should be implemented in the switching elements in order to handle the traffic flow of the reverse direction of the point-to-multipoint communication (multipoint-to-point). ATM cells arriving in different streams will be combined in one outgoing cell stream.

The complexity arising from the support of point-to-multipoint communications in the VC switched network, will be reflected either in the network architecture, the signalling functions and associated routing functions, the Operations Administration and Management (OAM) functionality and in the management procedures.

In addition to point-to-multipoint communication, multipoint-to-multipoint could also be envisaged. But for the moment no services requiring such configuration were identified. Further study is needed in this area.

It should be noted that the signalling protocol developed in the ATM Forum offers the point-to-multipoint capability.

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1 Scope

This ETSI Technical Report (ETR) outlines the state of the art on the issues raised by the introduction of multipoint communications in ATM based networks.

2 References

This ETR incorporates by dated and undated reference, provisions from other publications. These references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETR only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

[1] ITU-T Recommendation F.720: "Videotelephony services - General".

[2] ETR 338: "Broadband Integrated Services Digital Network (B-ISDN); Vocabulary for B-ISDN".

[3] ETR 085: "Transmission and Multiplexing (TM); Generic functional architecture of transport network".

3 Definitions and abbreviations

For the purposes of this ETR, the following definitions apply:

3.1 Definitions

communication: is the exchange of information between 2 or more subscribers according to agreed conventions (ITU-T Recommendation F.720 [1]).

point-to-multipoint communication: Communication between one (source) accesspoint and multiple (destination) accesspoints for bi-directional asymmetric or bi-directional symmetric communication.

multipoint-to-point communication: Communication between multiple (source) accesspoints and a single (destination) accesspoint for bi-directional asymmetric, bi-directional symmetric, or unidirectional communication. A unidirectional multipoint-to-point communication is called "**collection communication**" in this ETR.

multipoint-to-multipoint communication: Communication between multiple (source) accesspoints and multiple (destination) accesspoints for bi-directional asymmetric or bi-directional symmetric communication.

multicast communication: Unidirectional communication between one (source) accesspoint and a limited number (more than one) of specified destination accesspoints.

broadcast communication: Unidirectional communication between one (source) accesspoint and an unlimited number (more than one) of unspecified destination accesspoints.

connection: A connection provides for the capability of transferring information between endpoints. It represents the association between endpoints together with the incremental information regarding the information transfer integrity (ETR 338 [2]).

point-to-multipoint connection: Connection between one (source) endpoint and multiple (destination) endpoints for bi-directional asymmetric or bi-directional symmetric communication.

multipoint-to-point connection: Connection between multiple (source) endpoints and a single (destination) endpoint for bi-directional asymmetric, bi-directional symmetric, or unidirectional communication. A unidirectional multipoint-to-point connection is called "**collection connection**" in this ETR.

multipoint-to-multipoint connection: Connection between multiple (source) endpoints and multiple (destination) endpoints for bi-directional asymmetric or bi-directional symmetric communication.

multicast connection: Unidirectional connection between one (source) endpoint and a limited number (more than one) of specified destination endpoints.

broadcast connection: Unidirectional connection between one (source) endpoint and an unlimited number (more than one) of unspecified destination endpoints.

types of accesspoints/endpoints: With regard to the user flow, the following accesspoints/endpoints types are of relevance in a multipoint communication/connection:

– origination Accesspoint/Endpoint (Unidirectional outgoing);
– destination Accesspoint/Endpoint (Unidirectional incoming);
– bi-directional Accesspoint/Endpoint (symmetrical or asymmetrical).

Some examples:

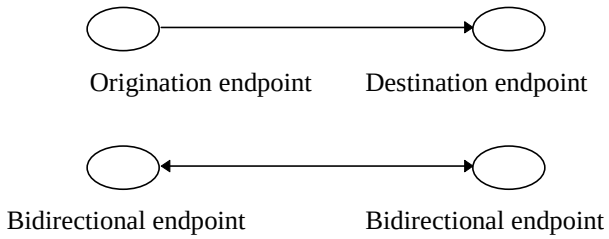


Figure 1: Different types of endpoints in a connection

communication/connection configurations: The communication/connection configurations only deal with:

– flows between accesspoints/endpoints, and flow distribution;
– directions of flows between accesspoints/endpoints.

The communication configurations do not deal with:

– physical switching points and their distribution over the connection;
– physical special resources and their distribution over the connection.

Multipoint communications/connections configurations involve many accesspoints/endpoints which are related to "party".

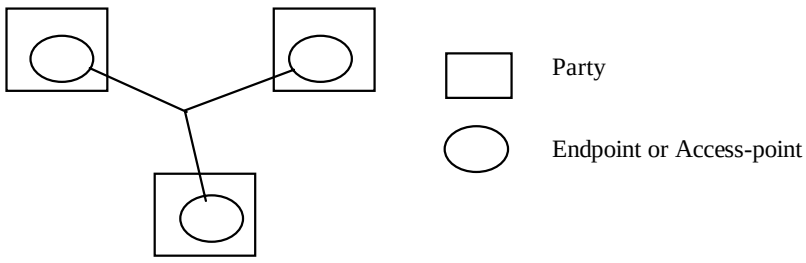


Figure 2: Multipoint communication

The following communications/connections configurations will be described in this document:

– point-to-multipoint and multipoint-to-point;
– multicast;
– broadcast;
– collection;
– multipoint-to-point.

3.2 Abbreviations

For the purposes of this ETR, the following abbreviations apply:

AAL	ATM Adaptation Layer
ABR	Available Bit Rate
ATM	Asynchronous Transfer Mode
B-ISDN	Broadband Integrated Services Digital Network
NNI	Network Node Interface
OAM	Operations Administration and Maintenance
QoS	Quality of Service
UNI	User Network Interface
VC	Virtual Circuit
VP	Virtual Path
VPI	Virtual Path Identifier
VCI	Virtual Channel Identifier

4 Special functions for multipoint configurations

4.1 Copying function

Definition

Copying is a function, enabling the information received to be copied dispatched to a number of destinations. The copy of information is performed at the ATM layer.

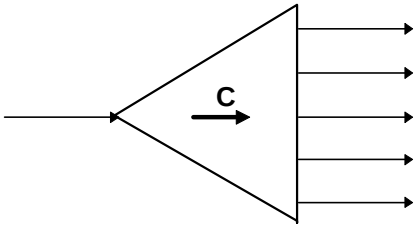


Figure 3: Copying

Description

The copying function has a VPI/VCI address list, made by provisioning or indicated by signalling. For every VPI/VCI address in the list, a new copy of the cell is made and the appropriate VPI/VCI address is inserted in the cell header.

The copying function copies transparently from the incoming cell to the outgoing cell:

- the payload;
- PTI bit 4 (user data cell indication), and 2(ATM-user-to-ATM-User indication).

The following functions are not part of the copying function, but have to be performed:

- Handling of the GFC field if appropriate;
- Putting a value to PTI bit 3 (congestion indication);
- Handling of the CLP bit;
- Generating the cell header HEC.

4.2 Merging function at the ATM layer

Definition

"ATM merging" is a function at the ATM layer which merges incoming ATM cells into one outgoing ATM cells flow without processing the payload of the cell.

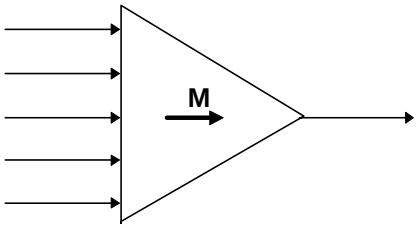


Figure 4: Merging

Description

The merging function at ATM layer has a VPI/VCI destination address for multiple originations, made by provisioning or indicated by signalling. For every of the originations, a new copy of the payload of an arriving cell is made and the appropriate destination VPI/VCI address is inserted in the cell header. This means that the traffic of all the originations is summed on the output of the merging function.

The merging function copies transparently from the incoming cell to the outgoing cell:

– the payload;
– PTI bit 4 (user data cell indication), and 2(ATM-user-to-ATM-User indication).

The following functions are not part of the merging function, but have to be performed:

– Handling of the GFC field if appropriate;
– Putting a value to PTI bit 3 (congestion indication);
– Handling of the CLP bit;
– Generating the cell header HEC.

4.3 Merging function at the higher layer

Definition

Application merging is a function, processing information of the same information type of different sources, according to a certain algorithm, to get a combined information stream of the same information type. An example of this is the combination of voices into a combined signal for all parties.

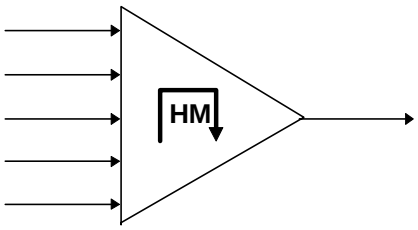


Figure 5: Merging at higher layer

Description

The merging function at higher layers is an application, combining, according to a combining algorithm, the information samples from the different leaves to one single sample which is communicated to the sink.

Combining algorithm: The combining algorithm is the method of combining the samples to one.

For voice the combining algorithm could be, e.g.:

– loudest speaker;

– weighted combination of all samples.

For video the combining algorithm could be e.g.:

– tile picture;

– picture of loudest speaker.

4.4 Bridging function at the ATM layer

Bridging is the combination of a merging function and a copying function both at ATM layer. It merges the inputs of the different endpoints, and then copies the resulting flow to the endpoints again.

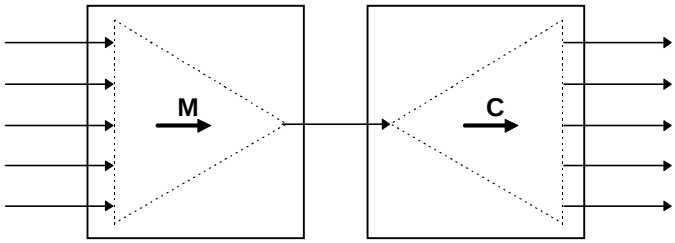


Figure 6: Bridging at ATM Layer

4.5 Bridging at the higher layer

In this case it is the combination of a copying function at the ATM layer and a merging function at the higher layer.

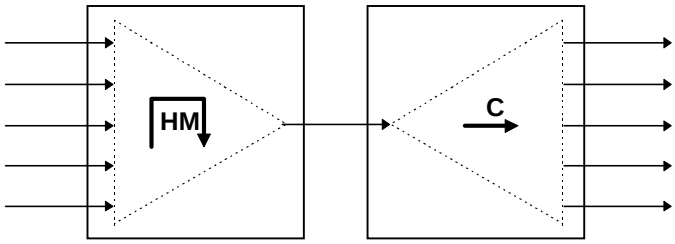


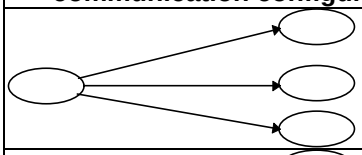
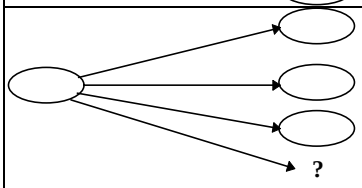
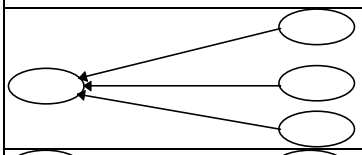
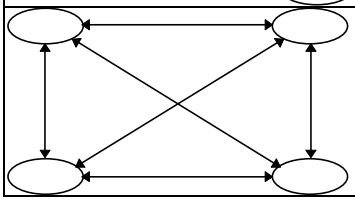
Figure 7: Bridging at higher Layer

4.6 Branching function

For further study.

5 Mapping of functions to communication configurations

Communications configurations show the various flows of information exchanged between the access points involved in the communication.

communication configuration	Type	function required
	Multicast	Copying(s)
	Broadcast	Copying(s)
	Collecting	Merging(s)
	Multipoint-to-multipoint	Bridging, or set of copying/merging

6 Multicast connection

6.1 Definition

A **multicast connection** is a switched (on-demand), semi-permanent, or permanent connection, transferring user and possibly other information from one endpoint called Root, to a defined number of remote endpoints, called Leaves.

A multicast connection is a special case of a point-to-multipoint connection. All flows (user and other - if appropriate) are only in one direction.

Figure 8 gives the logical configuration in terms of endpoints and information flows. Information flows covers all types of flows (user, OAM, resource management) but not signalling.

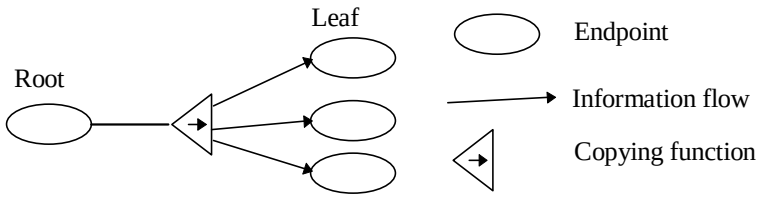


Figure 8: Multicast logical configuration

6.2 Ownership and related roles

Connection owner party

The Party related to the root endpoint, who establishes the connection and as such owns the connection.

The connection owner is the **only** party who may:

– re-negotiate the connection characteristics;
– add new Leaf Endpoints;
– drop existing Leaf Endpoints;
– release the complete connection.

Leaf party

A leaf party is not allowed to release the complete connection, but may disconnect itself from the connection.

6.3 Physical configuration

The physical realization of a multicast connection is shown in figure 9.

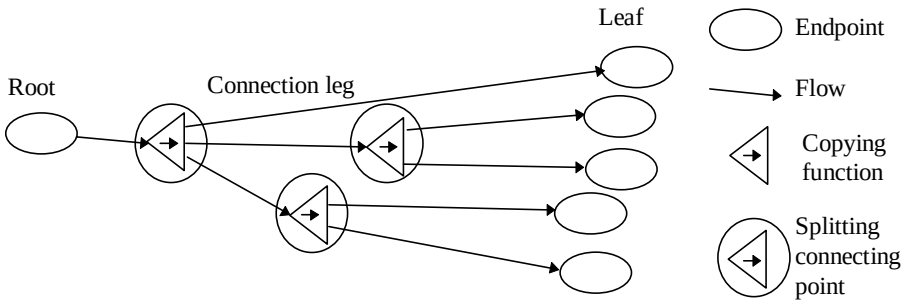


Figure 9: Physical configuration

Connection leg

A connection leg of a multicast connection is a part of the connection from a destination endpoint to the previous Splitting Connection point.

For the sake of optimization of network resources, Splitting connection points should be as close as possible to the leaves.

Splitting connecting point

The splitting Connecting point contains the copying function.

6.4 Controlling a multicast connection

A multicast connection is only possible if the root supports the multicast capability. Leaf parties may support at least point-to-point capability.

Start-up

The Root party takes the initiative to setup a multicast connection, and as such becomes the connection owner.

– the connection has to be characterized at setup as "Point-to-multipoint";

– the parties have to be identified by "(Party) Endpoint references";

- the communication could start with minimum 2 parties (Root + 1 Leaf), possibly with multiple parties (Root with multiple leaves);

- at connection setup, negotiation of connection characteristics is an option. The connection characteristics are negotiated with the first party(ies). Parties who can not comply with the accepted connection characteristics will not be involved in the multicast connection.

Maintaining the communication

- connection characteristics may possibly be re-negotiated later on. Only the connection owner can initiate connection re-negotiation. Acceptance of the connection's new characteristics is only possible if all present parties to agree them;

- more leaf parties can be added later on by the connection owner;

- it is not an option that leaf parties join the multicast connection by themselves;

- some parties can be dropped during the communication; the order of dropping does not have to be the same as the order of adding parties;

- leaf parties can take the initiative to leaf the multicast connection.

Releasing the connection

Only the connection owner is allowed to release the connection, as long as more than 3 parties are involved in the connection.

If only 2 parties are involved in the connection, this is considered as a 2-party connection. As such, if the remaining leaf party leaves the connection, the connection as a whole will be released.

6.5 Traffic and OAM issues

A multicast connection by definition is purely unidirectional. No backward Resource management cells or OAM cells are possible.

7 Broadcast connection

A broadcast connection has a lot of resemblance with a multicast connection. The broadcast connection is considered as from a distribution centre on a network towards all users on that network. An example could be some small bandwidth information such as teletext today.

A broadcast connection is a special case of a point-to-multipoint connection. All flows are (user and other - if appropriate) are only in one direction.

In practice the broadcast connection will be much more complicated, because it will be only part of a Broadcast Service, involving a distribution tree to which customers can access dynamically with the help of service providers, and possibly brokers.

7.1 Definition

A **broadcast connection** is a **permanent** communication, transferring user information from one endpoint called Root, to an **undefined** number of remote endpoints, called Leaves.

Figure 10 gives the logical configuration in terms of endpoints and information flows. Information flows covers all types of flows (user, OAM, resource management) but not signalling.

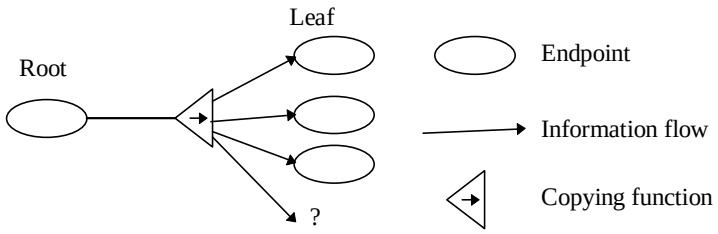


Figure 10: Broadcast logical configuration

7.2 Ownership and related roles

Connection owner party

The Party related to the root endpoint, who has requested the **permanent** broadcast connection to its network operator and as such owns the connection.

The connection owner has only control over the information sent over the connection. He has no idea of the leaf parties looking at the information at a particular time. It is however possible, for charging and other purposes, that some data concerning user's access periods is needed, and will be registered.

Leaf party

A leaf party is connected to the broadcast connection either:

– soon after the ATM layer of its terminal is activated, by an action originated by the network supporting the broadcast connection, in the case that the leaf party is subscribed permanently to the particular broadcast service;

– after an action of a leaf party who has a subscription to the broadcast connection on an on-demand basis.

7.3 Physical configuration

The physical realization of a broadcast connection is shown in figure 11:

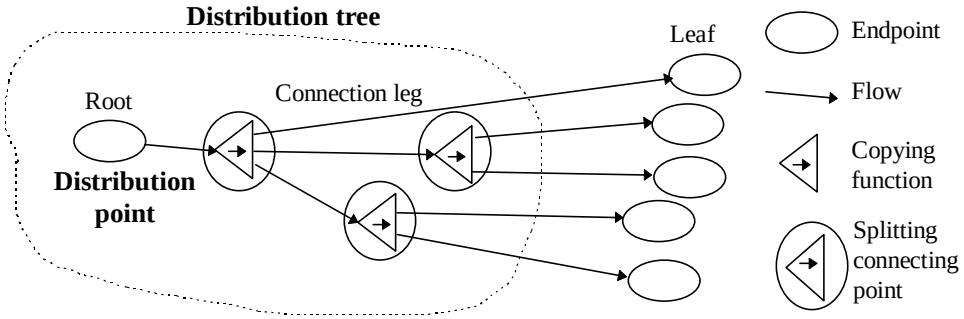


Figure 11: Physical configuration

Connection leg

A connection leg of a broadcast connection is a part of a connection from a destination endpoint to the previous Splitting Connection point.

For the sake of optimization of network resources, Splitting connecting points should be as close as possible to the leaves.

Splitting connecting point

The splitting connecting point contains copying function.*

Distribution point

The distribution point is the root party endpoint from which the user information is sent to the leaf parties.

Distribution tree

The distribution tree is the part of the connection which includes the Root and all the present splitting connection points. The connection legs do not belong to the distribution tree.

7.4 Controlling a broadcast connection

A broadcast connection is only possible if:

– the root party has a subscription with the network for using a distribution tree;

– the leaf party has a subscription to the network for access to the distribution tree, either permanent or on-demand.

Start-up

– The Root party, once its subscription is active, will send its information over the connection.

– A leaf party, having **permanent access** to the distribution tree, will get a **setup request from the network**, in order to negotiate the VPI/VCI.

– A leaf party, having **on-demand access** to the distribution tree, will have to **initiate a setup request** himself, in order to join the connection (set up the connection leg) and to negotiate a VPI/VCI. In this case, the connection should have a network address.

Maintaining the communication

– The root has **no control** on the leaves at all.

– Connection characteristics may not be re-negotiated later on.

– A leaf party, having permanent access to the distribution tree, is not able to release from the broadcast connection, except by powering down.

– A leaf party, having on-demand access to the distribution tree, will have to initiate a release request, in order to leave the connection (release the connection leg).

Releasing the connection

– The Root party can only release its connection by ending its subscription to the network.

7.5 Traffic and OAM issues

A broadcast connection is purely unidirectional by definition. No forward resource management cells or OAM cells are possible.

8 Collection connection

8.1 Definition

A **collection connection** is an on-demand, reserved, or permanent connection, transferring user information from a defined number of remote endpoints, called Leaves towards one endpoint called Root.

A collection connection is a special case of a multipoint-to-point connection. All flows (user and other - if appropriate) are only in one direction.

The next figure gives the logical configuration in terms of endpoints and information flows.

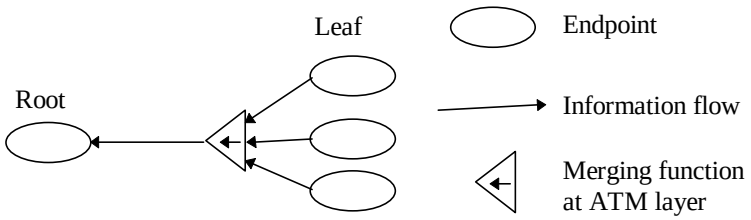


Figure 12: Collection logical configuration

8.2 Ownership and related roles

Connection owner party

The Party related to the root endpoint, who establishes the connection and as such owns the connection.

The connection owner is the **only** party who may:

- re-negotiate the connection characteristics;
- add new Leaf Endpoints;
- drop existing Leaf Endpoints;
- release the complete connection.

Leaf party

A leaf party is not allowed to release the complete connection, and is not allowed to release itself from the connection.

8.3 Physical configuration

The physical realization of a collection connection is shown in figure 13. Information flows covers all types of flows (user, OAM, resource management) but not signalling.

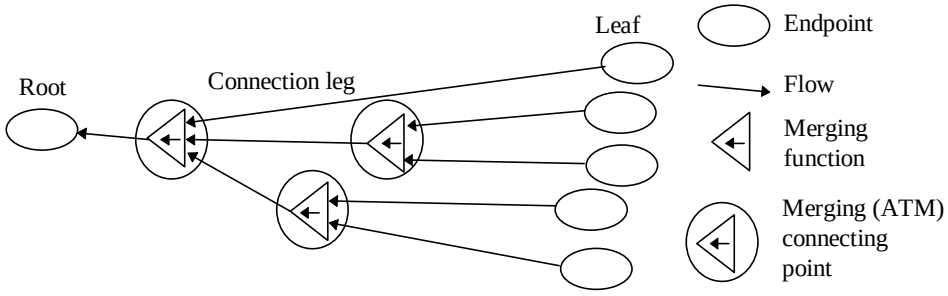


Figure 13: Physical configuration

Connection leg

A connection leg of a collection connection is a part of a connection from a destination endpoint to the previous Merging connecting point.

For the sake of optimization of network resources, Merging connecting points should be as close as possible to the leaves.

Merging connecting point

This point contains merging function.

8.4 Controlling an on-demand collection communication

A collection connection is only possible if both the root and the leaf parties support the collection capability.

Start-up

The Sink party takes the initiative to setup a collection connection, and as such becomes the connection owner.

– the connection has to be characterized at setup as "multipoint-to-point";

– the parties have to be identified by "(Party) Endpoint references";

– the communication could start with 2 parties (Sink + 1 Leaf), possibly with multiple parties (Sink with multiple leaves);

– at connection setup, negotiation of connection characteristics is an option. The connection characteristics are negotiated with the first party(ies). Parties who can not comply with the accepted connection characteristics will not be involved in the collection connection.

Maintaining the communication

– connection characteristics may possibly be re-negotiated later on. Only the connection owner can initiate connection re-negotiation. Acceptance of the connection's new characteristics is only possible if all present parties to agree them;

– more leaf parties can be added later on by the connection owner;

– it is not an option that leaf parties join the collection communication by themselves;

– some parties can be dropped during the communication; the order of dropping does not have to be the same as the order of adding parties;

– leaf parties cannot take the initiative to leave the collection communication.

Releasing the connection

Only the connection owner is allowed to release the connection.

8.5 Traffic and OAM issues

A collection connection is purely unidirectional by definition. No forward resource management cells or OAM cells are possible.

9 Point-to-multipoint connection (ATM layer merging)

9.1 Definition

A **point-to-multipoint connection with merging at the ATM layer** is a switched (on-demand), semi-permanent, or permanent communication, transferring a **bi-directional** symmetric or asymmetrical user and other information between one endpoint called Root, and a defined number of remote endpoints, called Leaves; the information from Leaves to Root is merged at the ATM layer.

Figure 14 gives the logical configuration in terms of endpoints and information flows. Information flows covers all types of flows (user, OAM, resource management) but not signalling.

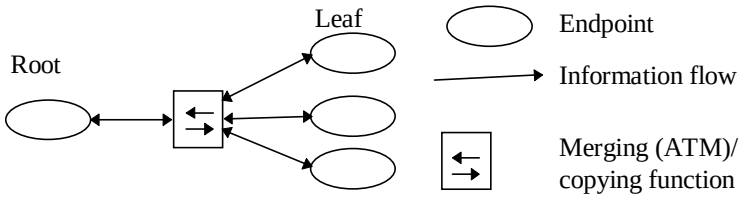


Figure 14: Point-to-multipoint logical configuration

9.2 Ownership and related roles

Connection owner party

The Party related to the root endpoint, who establishes the connection and as such owns the connection.

The connection owner is the **only** party who may:

– re-negotiate the connection characteristics;
– add new Leaf Endpoints;
– drop existing Leaf Endpoints;
– release the complete connection.

Leaf party

A leaf party is not allowed to release the complete connection, but may disconnect itself from the connection.

9.3 Physical configuration

The physical realization of a point-to-multipoint connection with merging at ATM layer is shown in figure 15:

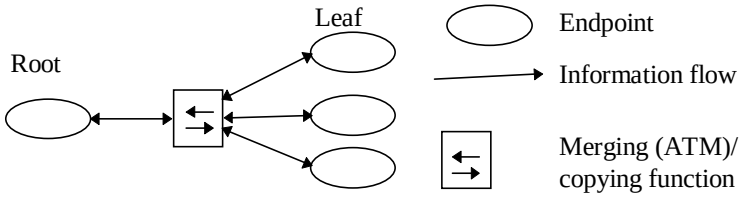


Figure 15: Physical configuration related to (bi-directional) point-to-multipoint

Connection leg

A connection leg of a point-to-multipoint connection is a part of a connection between a destination endpoint to the previous Branching Connection point. If the leaf party connected to the connection leg is leaving or being dropped, the connection leg is released.

For the sake of optimization of network resources, Branching connecting points should be as close as possible to the leaves.

Branching connecting point

This connecting point contains copying and merging functions at both ATM layer.

9.4 Controlling a point-to-multipoint connection

A point-to-multipoint connection is only possible if the root supports the point-to-multipoint capability.

Start-up

The Root party takes the initiative to setup a point-to-multipoint connection, and as such becomes the connection owner.

– the connection has to be characterized at setup as "(ATM Layer) Point-to-multipoint";

– the parties have to be identified by "(Party) Endpoint references";

– the communication could start with minimum 2 parties (Root + 1 Leaf), possibly with multiple parties (Root with multiple leaves);

– at connection setup, negotiation of connection characteristics is an option. The connection characteristics are negotiated with the first party(ies). Parties who can not comply with the accepted connection characteristics will not be involved in the point-to-multipoint connection.

Maintaining the connection

– Connection characteristics may possibly be re-negotiated later on. Only the connection owner can initiate connection re-negotiation. Acceptance of the connection's new characteristics is only possible if all present parties to agree them;

– More leaf parties can be added later on by the connection owner;

– It is not an option that leaf parties join the point-to-multipoint connection by themselves;

– Some parties can be dropped during the connection; the order of dropping does not have to be the same as the order of adding parties;

– Leaf parties can take the initiative to leaf the point-to-multipoint connection.

Releasing the connection

Only the connection owner is allowed to release the connection, as long as more than 3 parties are involved in the connection.

If only 2 parties are involved in the connection, this is considered as a 2-party connection. As such, if the remaining leaf party leaves the connection, the connection as a whole will be released.

9.5 Traffic and performance

The connection characteristics are as identified by the ATM Traffic descriptor and the QoS class.

The connection will have to be characterized by a certain traffic type (DBR, SBR, ABT, ABR,...). The traffic type will be the same over all segments and all the legs of the connection.

Some of these traffic types require resource management cells, which can have influence on other parts of the connection. Indeed, if in one leg there is a congestion, so that this leg asks to send less, all legs may get less.

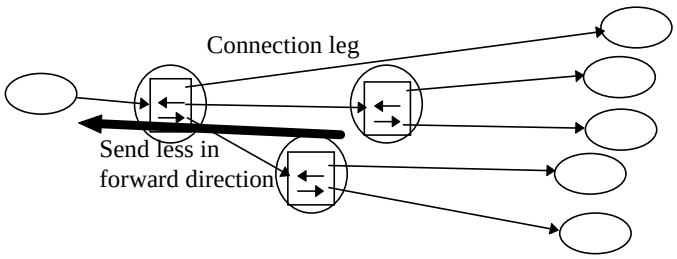


Figure 16: Influence of one leg on total flow

This is for further study.

The connection as a whole has been assigned some QoS characteristics, which have to be valid for the connection and all of its legs. The actual delays and delay variations may however differ from one leg to another. It is possible that a party cannot be added because the required QoS are not fulfilled for that party.

9.6 OAM issues

Specific issues are backward F5 flows (for a VCI connection), and backward F4 flow (for a VPI connection). This is only an issue if OAM flows are supported for multicast connections.

9.7 Bi-directionality of the point-to-multipoint connection

Even if the user information is only unidirectional from root to leaves, if:

– Resource management;

– OAM flows,

are supported, then the connection may be also be collecting in the backward direction.

Note that a **(bi-directional) point-to-multipoint connection** is different from a full multipoint-to-multipoint connection.

10 Point to multipoint communication (higher layer merging)

10.1 Definition

A **point-to-multipoint communication with higher layer merging** is a switched (on-demand), semi-permanent, or permanent communication, transferring a **bi-directional** symmetric or asymmetrical user and other information between one endpoint called Root, and a defined number of remote endpoints, called Leaves; the information from Leaves to root is merged at higher layers.

Figure 17 gives the logical configuration in terms of accesspoints and information flows. Information flows cover all types of flows (user, OAM, resource management) but not signalling.

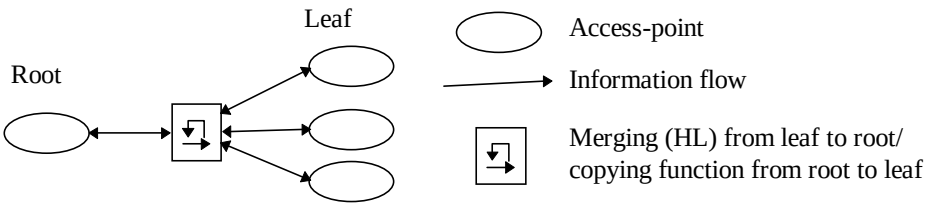


Figure 17: Point-to-multipoint logical configuration

10.2 Ownership and related roles

Communication owner party

The Party related to the root endpoint, who establishes the communication and as such owns the communication.

The connection owner is the **only** party who may:

– re-negotiate the communication characteristics;
– add new Leaf Endpoints;
– drop existing Leaf Endpoints;
– release the complete communication.

Leaf party

A leaf party is not allowed to release the complete communication, but may disconnect itself from the communication.

10.3 Physical configuration

The physical realization of a point-to-multipoint connection is shown in the next figure.

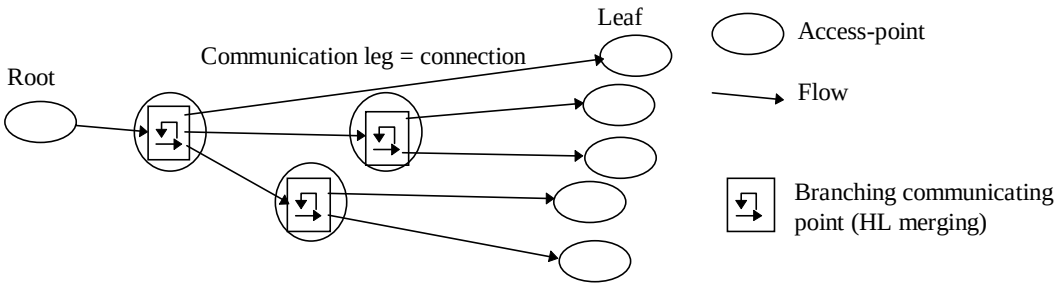


Figure 18: Physical configuration related to (bi-directional) HL point-to-multipoint configuration

Communication leg

A communication leg of a point-to-multipoint communication is a connection from a destination endpoint to the previous Branching communicating point.

– The complete configuration is considered as **one** point-to-multipoint **communication**, independent of the number of Leaf Endpoints, and consists of a number of point-to-point connections;

– For the sake of optimization of network resources, Branching communicating points should be as close as possible to the leaves.

Branching communicating point

This point contains copying function at ATM layer and merging at higher layer.

10.4 Controlling a bi-directional point-to-multipoint communication

A point-to-multipoint communication is only possible if both the root supports the point-to-multipoint capability.

The control actions of a bi-directional point-to-multipoint communication are for further study.

10.5 Traffic and performance

This section gives preliminary information on traffic and performance of point-to-multipoint communications. It needs further studies.

The communication characteristics are as identified by the ATM Traffic descriptor and the QoS class.

The communication will have to be characterized by a certain traffic type (DBR, SBR, ABT, ABR,...). The traffic type will be the same over all trails and of the communication and parts of it.

Some of these traffic types require resource management cells, which can have influence on other parts of the connection. Indeed, if in one communication leg there is a congestion, so that this leg asks to send less, all legs may get less.

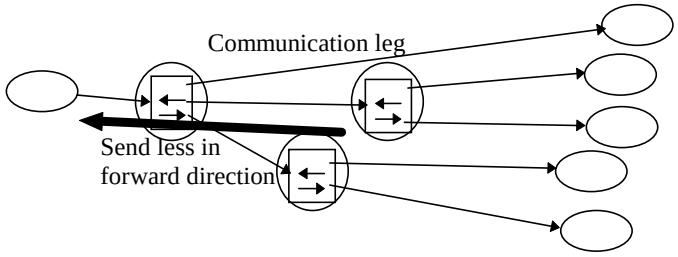


Figure 19: Influence of one leg on total flow

The communication as a whole has been assigned some QoS characteristics, which have to be valid for the communication configuration and all of its parts. The actual delays and delay variations may however differ from one leg to another. It is possible that a party cannot be added because the required QoS are not fulfilled for that party.

10.6 OAM issues

For further study.

10.7 Bi-directionality of the point-to-multipoint communication

Even if the user information is only unidirectional from root to leaves, if resource management is supported, then the communication may be also be collecting in the backward direction.

The inter-connection resource management is however for further study.

11 Collection communication (high layer merging)

11.1 Definition

A **collection communication** is a switched (on-demand), semi-permanent, or permanent communication, transferring user information from a defined number of remote endpoints, called Leaves, towards one endpoint called Root.

Figure 20 gives the logical configuration in terms of accesspoints and information flows. Information flows covers all types of flows (user, OAM, resource management) but not signalling.

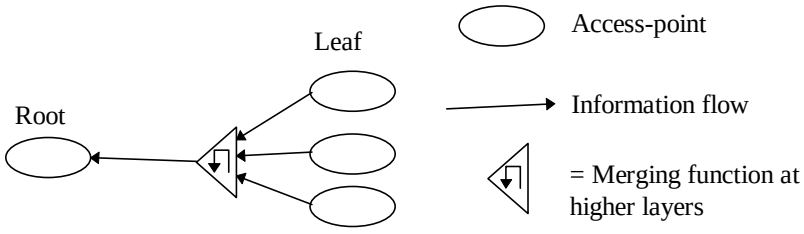


Figure 20: Collection logical configuration

11.2 Ownership and related roles

Communication owner party

The Party related to the root accesspoint, who establishes the communication and as such owns the connections needed for the communication.

The connection owner is the **only** party who may:

- re-negotiate the communication characteristics;
- add new Leaf Endpoints;
- drop existing Leaf Endpoints;
- release the complete communication.

Leaf party

A leaf party is not allowed to release the complete communication, and is not allowed to release itself from the communication.

11.3 Physical configuration

The physical realization of a collection communication is shown in figure 21:

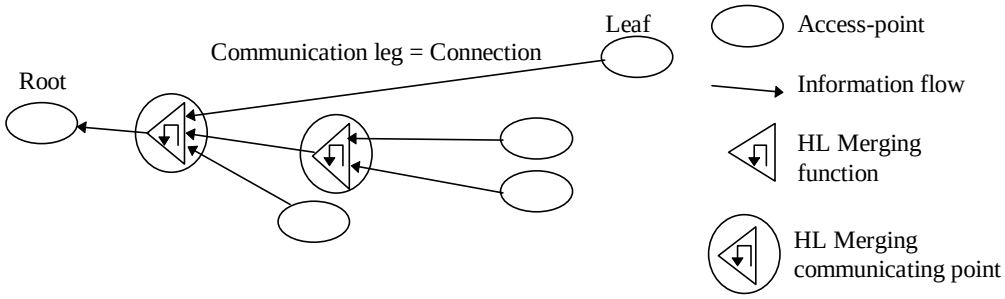


Figure 21: Physical configuration

(HL) Merging communication point

This point contains Merging function at higher layer.

Collecting communication leg

A Collecting communication leg of a collection communication is a part of a collection communication from a destination endpoint to the Merging Connection point.

For the sake of optimization of network resources, the Merging connection point should be as close as possible to the leaves.

11.4 Controlling an on-demand collection communication

For further study.

11.5 Traffic and OAM issues

A collection communication is purely unidirectional by definition. No forward resource management cells or OAM cells are possible.

12 Multipoint-to-multipoint communications

12.1 Definition

The multipoint-to-multipoint communication provides the capability that all parties can communicate with each other (figure 21).

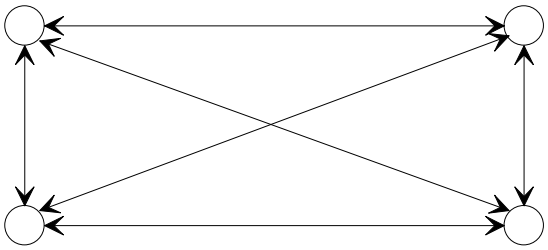


Figure 22: Multipoint-to-multipoint communication

In the following, several alternatives to provide multipoint-to-multipoint communications supported over a set of simpler ATM connections are identified.

12.2 Connection configurations

The configuration of figure 22 uses only point-to-point connections. This is not a realistic case: a lot of connections have to be established. Therefore, the network cost is very high even if the number of users (4 in the example) is small.

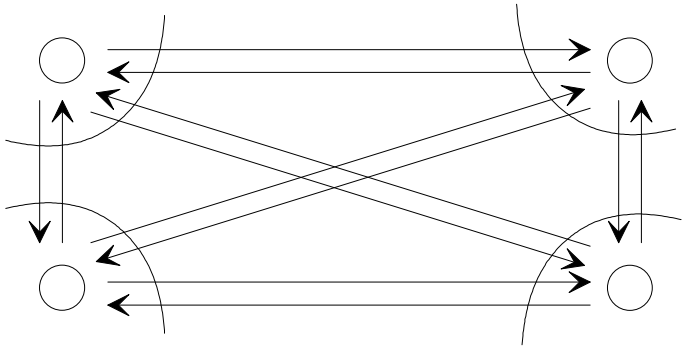


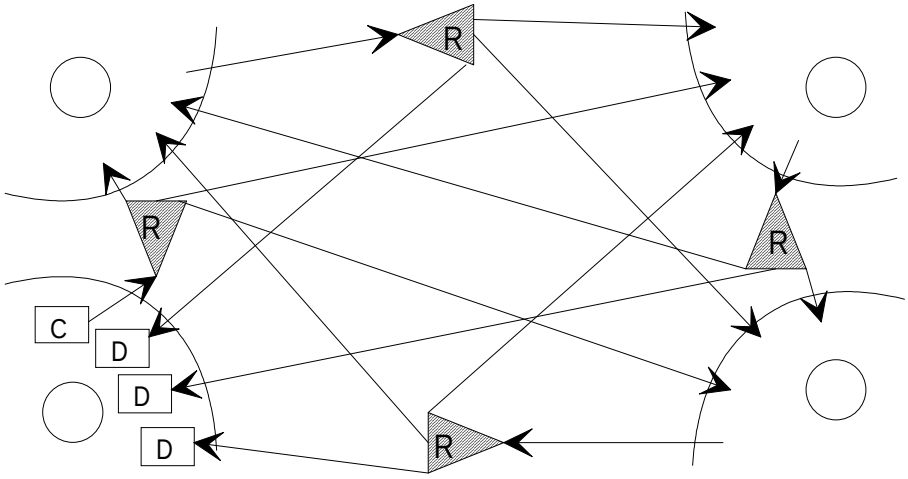
Figure 23: Multipoint-to-multipoint communication supported by point-to-point connections

The configuration of figure 23 has the also several drawbacks:

- It is necessary to establish N point-to-multipoint connections for N users involved in the communications;

- N-1 decoders are needed, leading, probably, to an expensive user equipment.

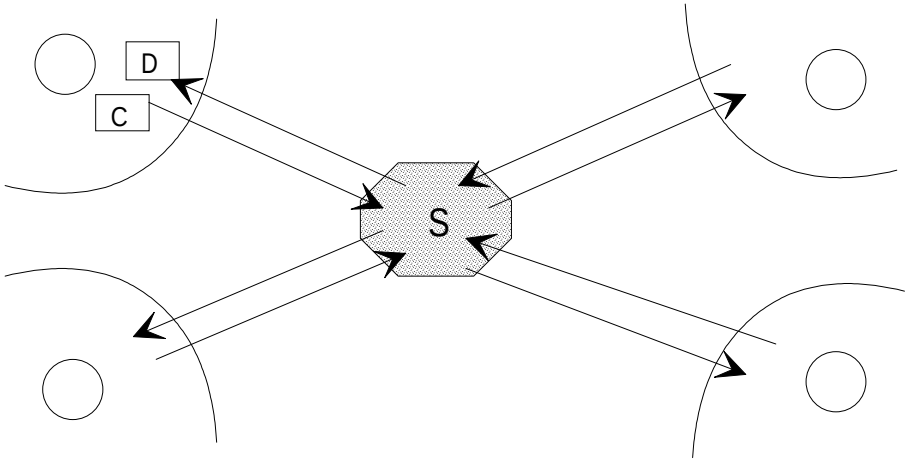
This is the technique depicted by the ATM Forum to support multipoint-to-multipoint communication. ATM Forum phase 1 signalling does not support multipoint-to-multipoint connections. Instead, techniques involving point-to-multipoint connections are used (see figure 23).



R = replicating function
C = coding
D = decoding

Figure 24: Multipoint-to-multipoint communication supported by point-to-multipoint connection

When a server implementing multipoint-to-multipoint facility (figure 24), the network configuration is very simple. Only point-to-point connections have to be established in the network. The user will pay his connection and additional charge for the use of the server. The user equipment is simple, complexity is introduced in the server. This will be used when the network do not provide point-to-multipoint connection. If UNI signalling protocols are used, the establishment should be performed without problems. In case of NNI, some additional complexity should have to be added to the protocol.

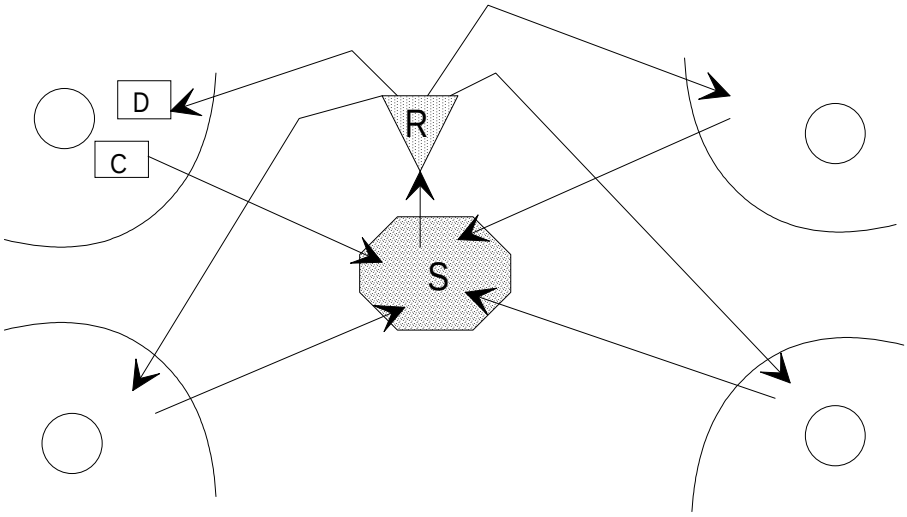


C = coding
D = decoding
S = Server for multipoint communication

Figure 25: Multipoint-to-multipoint communication supported by point-to-point connections and a server

In this case (figure 24), the server will work at application level, combining the different information to be delivered to the users. A detailed description of the functional characteristics of this server is left for further study.

Figure 25 is an alternative of figure 4 where network supports point-to-multipoint connections. A point-to-point unidirectional (or bi-directional) connection is established to the server. The server establishes a point-to-multipoint connections to each of the users involved.



C = coding
D = decoding
S = Server for multipoint communication
R = replicating function

Figure 26: Multipoint-to-multipoint communication supported by point-to-point unidirectional connections, one point-to-multipoint connection and a server

The functional characteristics of this server will be, in principle, similar (but not identical) to the functional characteristics of the server in figure 4. It is left for further study to clarify the possible differences between them.

The main characteristics associated to each one of the two last options (using a multipoint server) are summarized in the following table:

	Figure 24	Figure 25
Application aspects	Same complexity in both solutions at the application level (combining or merging information flows [picture, video, voice, etc.]).	
Management aspects	Management of point-to-point connections (setup, release, etc.) - the connections can be established either by the users or by the server, according to the application.	Management of point-to-point connections (setup, release, etc.). This applies to the communication user to server. - the connections can be established either by the users or by the server, according to the application. Management of point-to-multipoint connection (e.g. add party, drop party, etc.). This applies to the communication server to user. - the point-to-multipoint is under the control of the server.
Traffic aspects	If BR is the bit rate towards each user, the traffic getting out of the server is equal to BR $\times$ number of users.	Only BR towards the network.

13 Capability for point-to-multipoint at the ATM layer

Two configurations for point-to-multipoint have been identified, one dealing with the VP and one with the VC. The main issues are:

- the reverse direction;
- the identification of the leaf;
- the management and the maintenance of the configuration; and
- the traffic control.

The two following figures are examples of point-to-multipoint configuration that should be taken into account in the work programme. Other configurations are for further study. It should be noted that a leaf cannot send information to another leaf.

13.1 VP point-to-multipoint

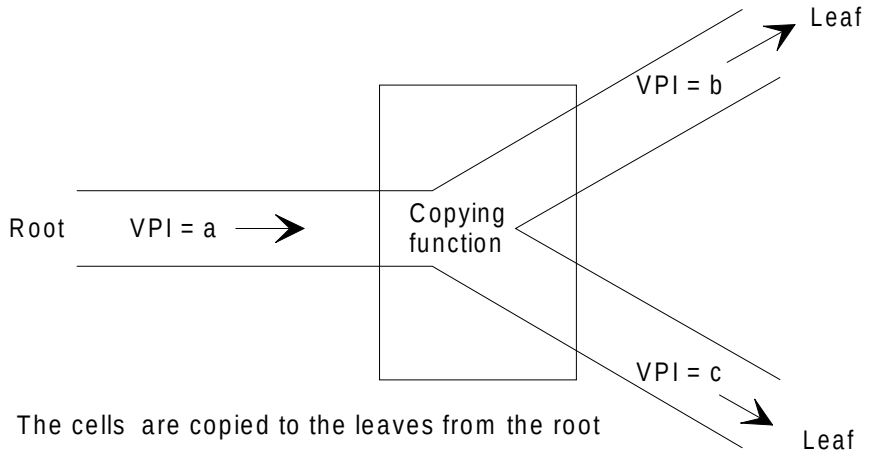


Figure 27: VP point-to-multipoint, from root to leaves

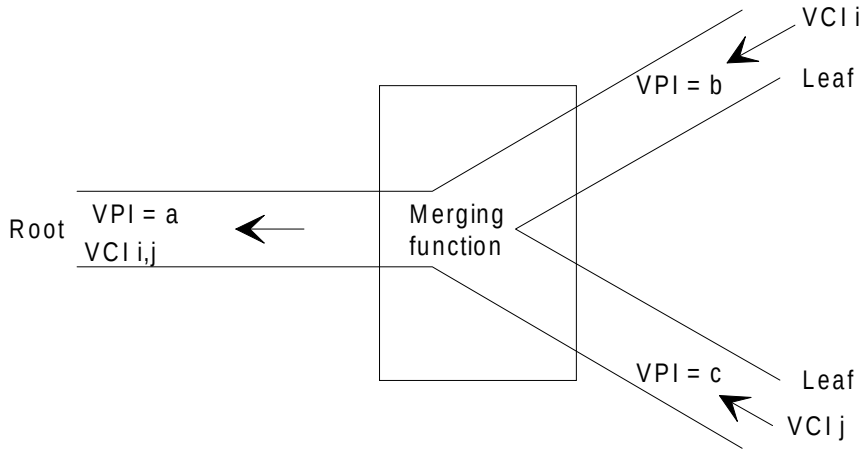


Figure 28: VP point-to-multipoint, from leaves to root

In the configuration of figures 27 and 28, a leaf is identified by a specific VCI value from the reverse direction. The main issue is the management of the VCI values, namely the sharing of the VCI values among the leaves. This is one way to identify the reverse direction as it was agreed to allocate the same identifier (VCI and VPI) for both direction of the communication. In the VP configuration the management of the values is done by the users (root + leaves), VCI values are not modified by the network.

For the maintenance of such configuration, F4 flows are used. As the same VCI value is allocated in both directions, the only mean to identify from which leaf is coming the F4 flow is to introduce an identifier within the OAM cell.

13.2 VC point-to-multipoint

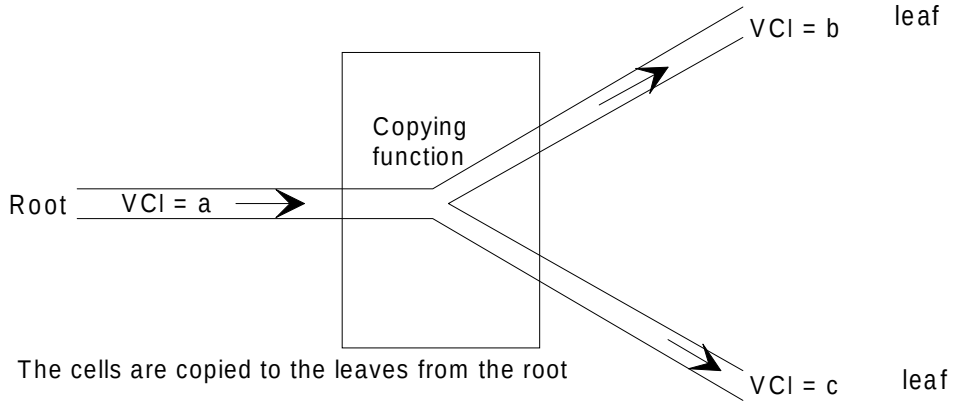


Figure 29: VC point-to-multipoint, from root to leaves

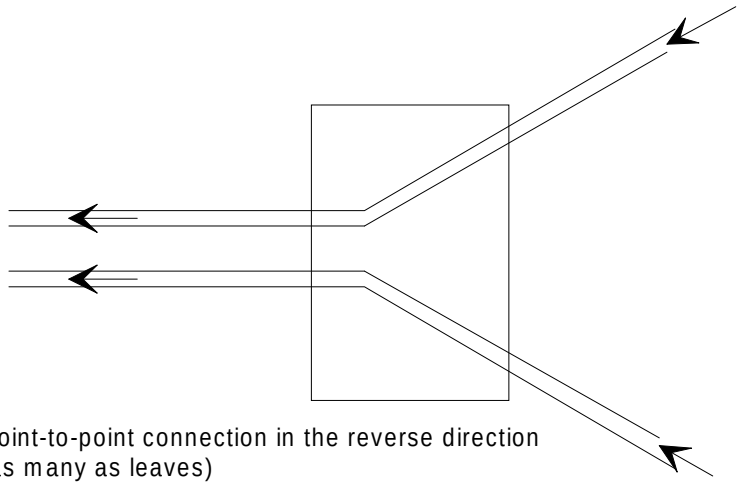


Figure 30: VC point-to-multipoint connection at the ATM layer

Figures 29 and 30 show a VC point-to-multipoint connection. Two ways are foreseen to identify the leaves: identifier in the payload or use another link to carry the information of the reverse direction. The first proposal will increase the overhead and processing time. For the reverse direction it is proposed in case of a VC point-to-multipoint to use another point-to-point VC connection to carry the information from the leaves to the root.

The maintenance is divided into two parts: the maintenance of the point-to-multipoint configuration (figure 29) and the maintenance of the point-to-point connection (figure 30). For the point-to-multipoint configuration, an identifier of the leaves is to be introduced in the payload of the F5 OAM flow. For point-to-point connection, the usual OAM F5 flow is used.

14 Network scenario for point-to-multipoint unidirectional communications in a VC switched environment

Figure 31 outlines one network scenario for point-to-multipoint unidirectional communications in a VC switched environment. In this scenario, VC switches are added at the edge of a VP cross connected network.

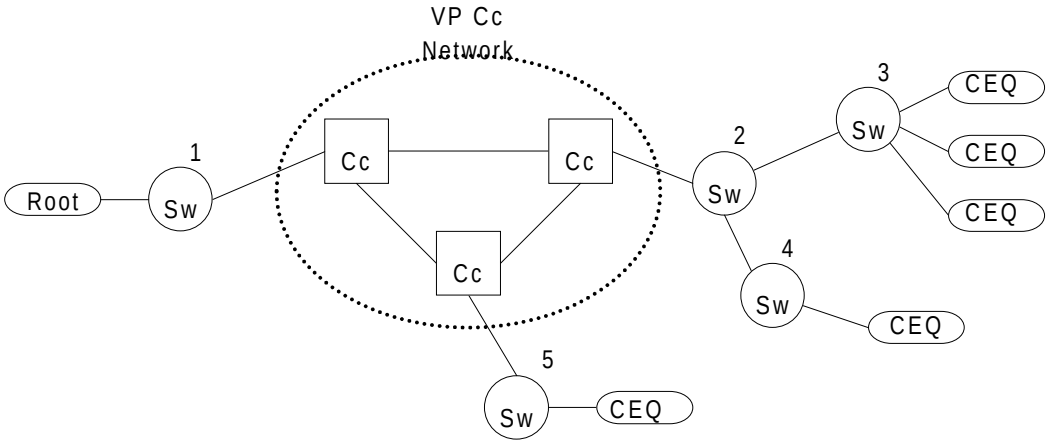


Figure 31: General network configuration

The user accesses the network through VC switches. The VP cross-connects appear to form a backbone network to transport the ATM cells among those VC switches. In this scenario only the VC switches will incorporate replication/merging functions. This is because the VP cross connects are only used for establishing the VP backbone network over which the VC switched network will be built. This is probably the most predictable scenario to exist in an early stage of the introduction of VC switches.

Specific information on the existing VP connections among VC switches, and their associated parameters (e.g. bandwidth, QoS class, ...), could be passed between the different operating system of switches by means of a Xcoop interface. Such information will be used to update the VC switches management information data bases, where it plays an important part in the routing decision process during a call/connection set-up phase.

15 Open issues on point-to-multipoint

15.1 Management: modelling of multipoint configuration

A model of this point-to-multipoint connection could be useful in order to define managed object. A definition of this multipoint connection could be:

– an ATM multipoint connection is the association of network resources up to the ATM layer providing the capability of transferring information between all the ATM connection endpoints involved in the multipoint connection. No functions at higher layers (AAL and above) and above are involved.

If TMN is involved in the provision of ATM multipoint configurations, a description of these configurations in terms of transport network aspects (ETR 085 [3]) is needed. This is under study.

15.2 Maintenance of point-to-multipoint connection

Information from RWP OAM will be used.

15.3 Location of the duplication/merging functions

In principle either the VC switches or the VP cross-connects can act as a duplication point.

The branching point can be at different locations in the communication path, preferably as near to the terminating point as possible. This is of great importance for the minimization of transmission costs, specially in the case of international calls.

15.4 Signalling/routing issues

Routing mechanisms, in the present case of multi-point connections, assumes particular importance in the sense that it is necessary to keep a complete trace of each of the paths established during the call set-up.

Still, several network parameters may change during the complete establishment of the call. These parameters are mainly associated to the availability of resources in the switches to perform duplicating/merging functions.

Although some of the duplicating functions in the switch do not need to be completely duplicated, in order to handle more than two leaves in the same branching point, the duplicating/merging process is a very resource consuming process, and therefore it can be expected some limitation from the VC switches in handling a large number of branches.

Routing algorithms should be aware from the start, of the multicast nodes available in the network and in which ways they can be reached.

Furthermore, as a multipoint connection is being established, information should be kept on the resources still available, in terms of duplicating/merging functionality, in each of the multicast switches along the different communication paths.

15.5 Bi-directional point-to-multipoint connection

The configurations and the functions of all the boxes of the following should be better defined:

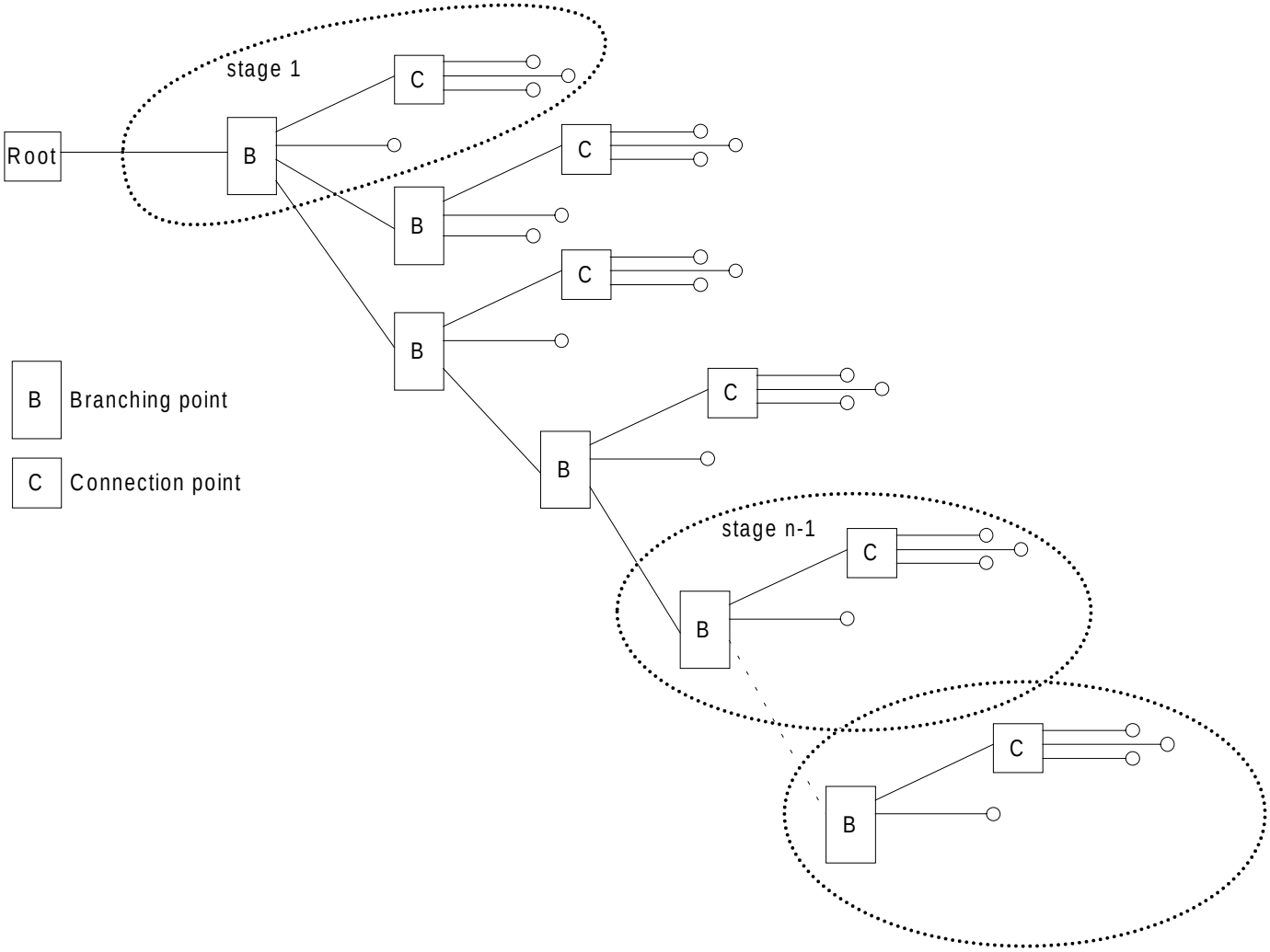


Figure 32: Example of configuration

– what are the configurations we want to take into account?

– what are the functionalities of a branching point?

– how many outlets on a branching point?

– how many stages are allowed?

– what are the functionalities of a connecting point?

– how many leaves on a connecting point?

– define the merging function;

– how to keep a complete trace of the paths associated to an on demand connection (necessary for routing)?

– etc.

History

Document history	
May 1997	First Edition

ISBN 2-7437-1373-9
Dépôt légal : Mai 1997