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M.3100

Amendment 4

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SERIES M: TMN AND NETWORK MAINTENANCE: INTERNATIONAL TRANSMISSION SYSTEMS, TELEPHONE CIRCUITS, TELEGRAPHY, FACSIMILE AND LEASED CIRCUITS

Telecommunications management network

Generic network information model

Amendment 4: Definition of the management interface for a bridge-and-roll cross-connect feature

ITU-T Recommendation M.3100 – Amendment 4

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ITU-T Recommendation M.3100

Generic network information model

AMENDMENT 4

Definition of the management interface for a bridge-and-roll cross-connect feature

Summary

This amendment provides a new generic capability for cross-connect with bridge-and-roll capability. The bridge and roll process is used to move traffic from one facility to another facility without disruption. This process requires co-ordination across multiple network elements to ensure that the traffic is not disrupted. Bridge/roll/release is for re-configuration and accomplished manually, i.e through management operations.

Source

Amendment 4 to ITU-T Recommendation M.3100 was prepared by ITU-T Study Group 4 (2001-2004) and approved under the WTSA Resolution 1 procedure on 13 August 2001.

Keywords

Actions, ASN.1, Attributes, Cross-connect, Managed Object Class, Notifications, Requirements.

FOREWORD

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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.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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Definition of the management interface for a bridge-and-roll cross-connect feature

1 Scope

The bridge and roll process is used to move traffic from one facility to another facility without disruption. This process requires co-ordination across multiple network elements to ensure that the traffic is not disrupted. Bridge/roll/release is for re-configuration and accomplished manually, i.e. through management operations.

This feature applies to unidirectional, bidirectional and multicast connections.

1.1 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions for this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; all 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.

[1] ITU-T M.3010 (2000), *Principles for a telecommunications management network.*

[2] ITU-T M.3020 (2000), *TMN interface specification methodology*.

[3] ITU-T M.3100 (1995), *Generic network information model*.

[4] ITU-T M.3120 (2001), *CORBA generic network and NE level information model*.

[5] ITU-T M.3400 (2000), *TMN management functions*.

2 Abbreviations

This Recommendation uses the following abbreviations:

ASN.1 Abstract Syntax Notation One

GDMO Guidelines for the Definition of Managed Objects

TMN Telecommunications Management Network

3 Terms and definitions

This Recommendation defines the following terms.

3.1 bridge operation: Causes traffic from the unchanged facility to be bridged to both the from-facilities and to-facilities. The unchanged facility still receives traffic from the from-facility. This operation is applicable only to the source side of the signal.

3.2 from-facility: Is part of the current connection, and will not be part of the new connection.

3.3 release operation: Drops the connection between the unchanged-facility and the from-facilities. This operation is applicable only to the source side of the signal.

3.4 roll operation: Causes the unchanged-facility to receive traffic from the to-facility. This operation is applicable only to the sink side of the signal.

3.5 to-facility: Is not part of the current connection, but will be part of the new connection.

3.6 unchanged-facility: Is part of the current connection and will be part of the new connection.

4 Business requirements

This clause describes the generic Bridge-and-Roll cross-connect business requirements.

The bridge and roll process is used to move traffic from one facility to another facility without disruption. While the bridge and roll functions are separately managed within each NE, the overall process requires co-ordination across multiple network elements to ensure that the traffic is not disrupted. The logic of the bridge/roll/release is similar to protection switching, however the applications are different. Protection switching is for restoration (recovery) and could be accomplished automatically (through signalling) or manually. Bridge/roll/release is for re-configuration and accomplished manually, i.e. through management operations.

The bridge and roll functions are described in terms of three facilities on the network element:

- The *unchanged facility* is part of the current connection and will be part of the new connection.
- The *from facility* is part of the current connection, and will not be part of the new connection.
- The *to facility* is not part of the current connection, but will be part of the new connection.

The operations involved in a bridge and roll are defined as follows:

- The *bridge* operation causes traffic from the unchanged facility to be bridged to both the "from facilities" and "to facilities". The unchanged facility still receives traffic from the "from facility". This operation is applicable only to the source side of the signal.
- The *roll* operation causes the "unchanged facility" to receive traffic form the "to facility". This operations is applicable only to the sink side of the signal.
- The *release bridge* operation drops the connection between the "unchanged facility" and the "from facilities". This operation is applicable only to the source side of the signal.

4.1 High-level use cases

The terminology used in the use cases is based on terminology defined in this Recommendation and terminology defined in ITU-T M.3400: 2000, *TMN Management Functions*.

The set of use cases provided here is not exhaustive and is left as an exercise to the reader. Only that which was deemed necessary to clarify the need and the feature requirements is included.

This clause describes an example scenario where it is necessary to perform each of the three steps independently to ensure that the traffic is not disrupted. The key to the scenario is that there are two simultaneous bridge and roll processes that need to be coordinated to avoid a traffic disruption.

4.1.1 Use case 1 – two network elements, two facilities

The simplest case is two network elements, with two facilities connecting them. While this may not be particularly realistic, it does serve to illustrate the issue of coordination between the bridge and roll process in the two network elements. More realistic configurations would involve additional elements, but they do not change the fundamental process that is described in this example. In the

diagrams that follow (see Figure 1), boxes represent network elements, thick lines represent facilities, and thin lines with arrows represent connectivity within the network elements.

Traffic is initially on one facility, and is to be moved to the other.

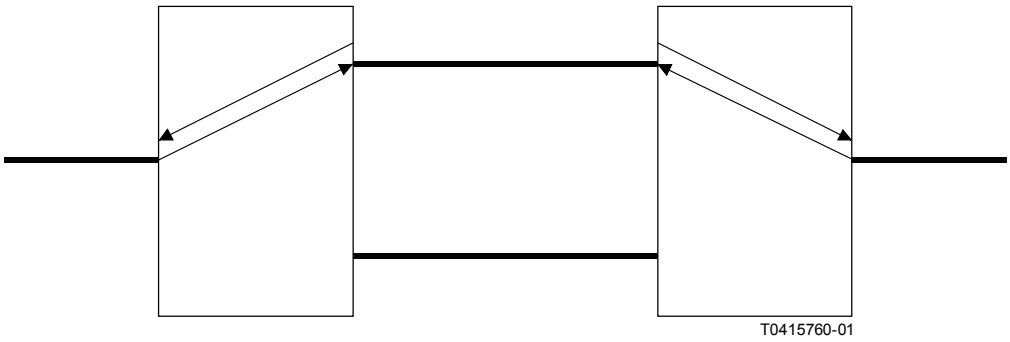

Figure 1/M.3100 – Initial configuration

Using the present switchover action for fabricR1 from ITU-T M.3100, traffic is lost unless there is precise coordination between the network elements. Unless the switchover command is executed at exactly the same time in both NEs, traffic is lost between the time that one NE is switched over and the time that the other NE is switched over from the *from facility* to the *to facility.* See Figure 2.

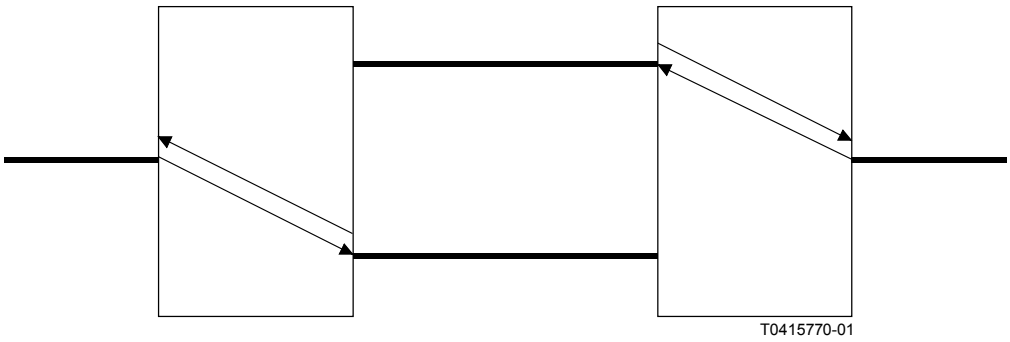

Figure 2/M.3100 – Coordination problem when using switchover action

Using the bridge and roll process, traffic is first bridged to the new facility in both network elements. Note that both network elements still receive traffic from the top facility. See Figure 3.

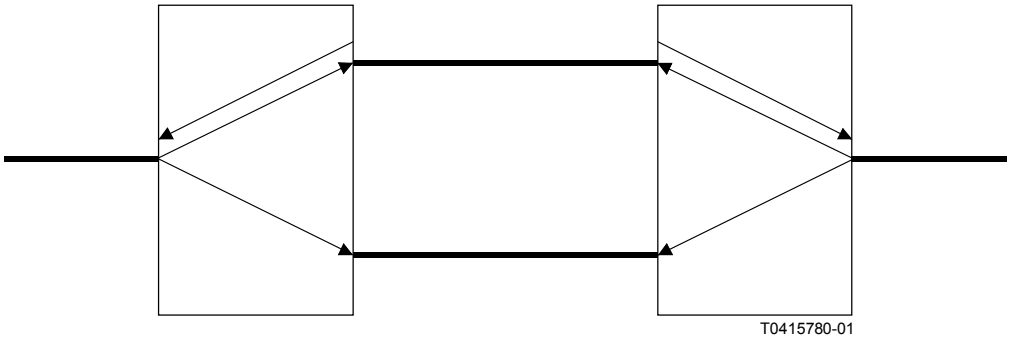

Figure 3/M.3100 – Traffic bridged to new facility

If the roll and release operations are combined for the bridge and roll process, the flow of traffic will be disrupted unless the roll/release command is executed at exactly the same time in both network elements. Figure 4 shows the result of the roll/release being preformed in only one of the network elements. The network element on the left is still receiving traffic; the NE on the right is not, since it has not yet rolled, and the left NE has dropped its bridge.

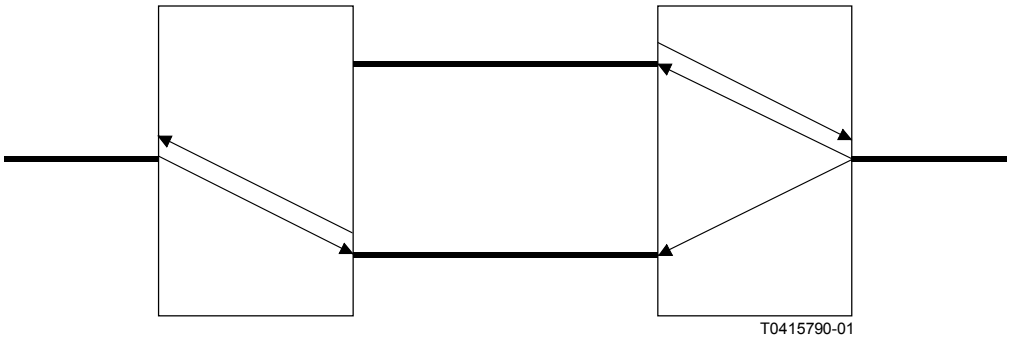

Figure 4/M.3100 – Coordination problem when roll and release are combined

If the roll and release are separate operations, a roll can be performed at each network element, and then a release can be performed in each element. This eliminates the synchronization issue and ensures that the traffic is not disrupted. Figure 5 shows the configuration after the roll operation has been performed in one network element. Traffic has not been disrupted, since the bridge is still in place. From here, the roll is done in the second NE, and then both bridges are released.

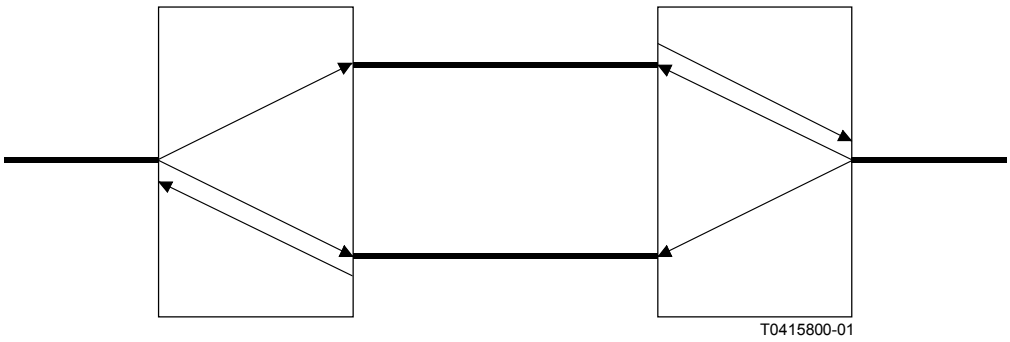

Figure 5/M.3100 – Configuration after roll operation in one NE

5 Analysis

This clause shows how the bridge and roll model affects the configuration of the NE. The specific details of how the model works vary with the type of connection, based on the directionality, the connection type, and which end of the connection is being bridged.

5.1 Bidirectional connection

Figures 6 to 9 depict the series of steps to bridge and roll a bidirectional point-to-point connection within a single NE (CTP containers are omitted for clarity).

Figure 6 shows a cross-connection between two CTPs, and a third unused CTP:

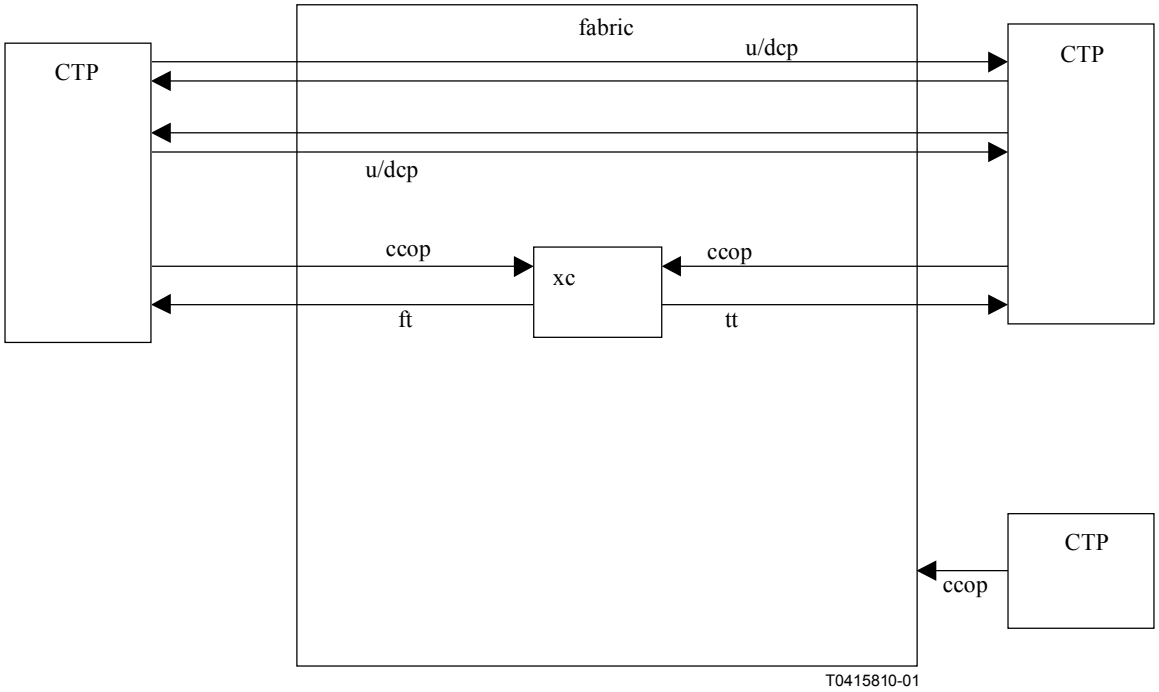

Figure 6/M.3100 – Initial configuration (point-to-point bidirectional)

Figure 7 shows the configuration after the bridge operation. A new one-way cross-connection has been created between the CTP on the left and the lower CTP on the right. The configuration of the bidirectional cross-connection is unaffected.

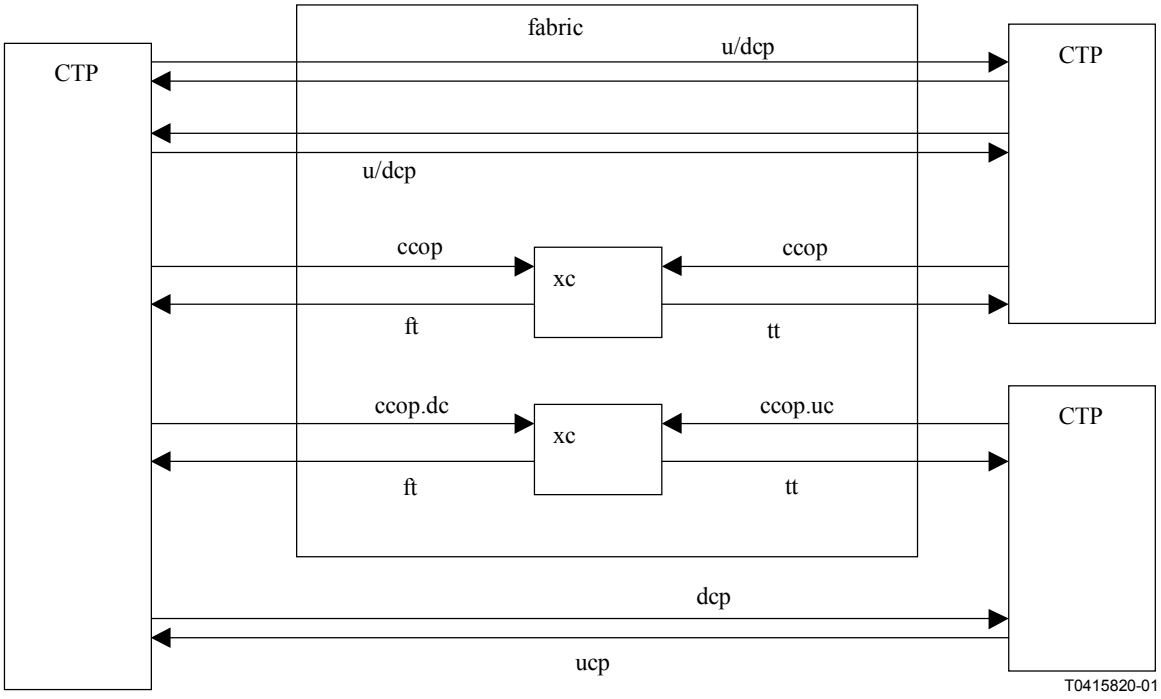

Figure 7/M.3100 – Bridge operation (point-to-point bidirectional)

Figure 8 shows the configuration after the roll operation. The top cross-connection is now unidirectional, and the bottom one is bidirectional.

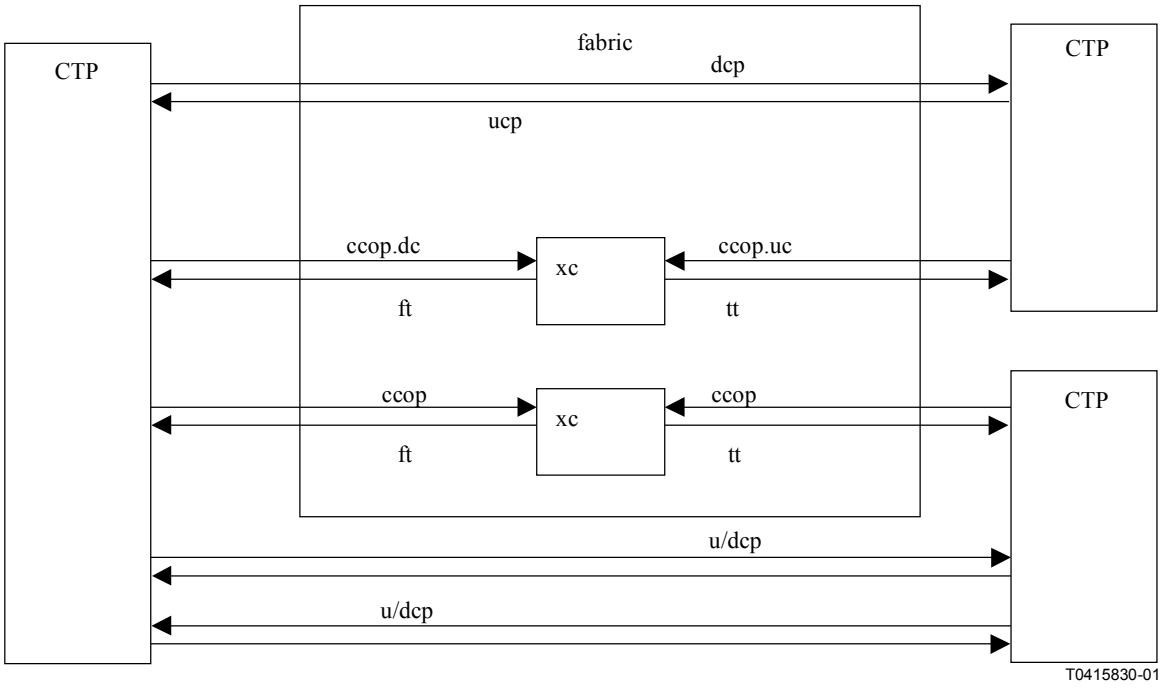

Figure 8/M.3100 – Roll operation (point-to-point bidirectional)

Figure 9 shows the configuration after the release operation. The unidirectional cross-connection has been deleted, and traffic now flows only between the left CTP and lower right CTP.

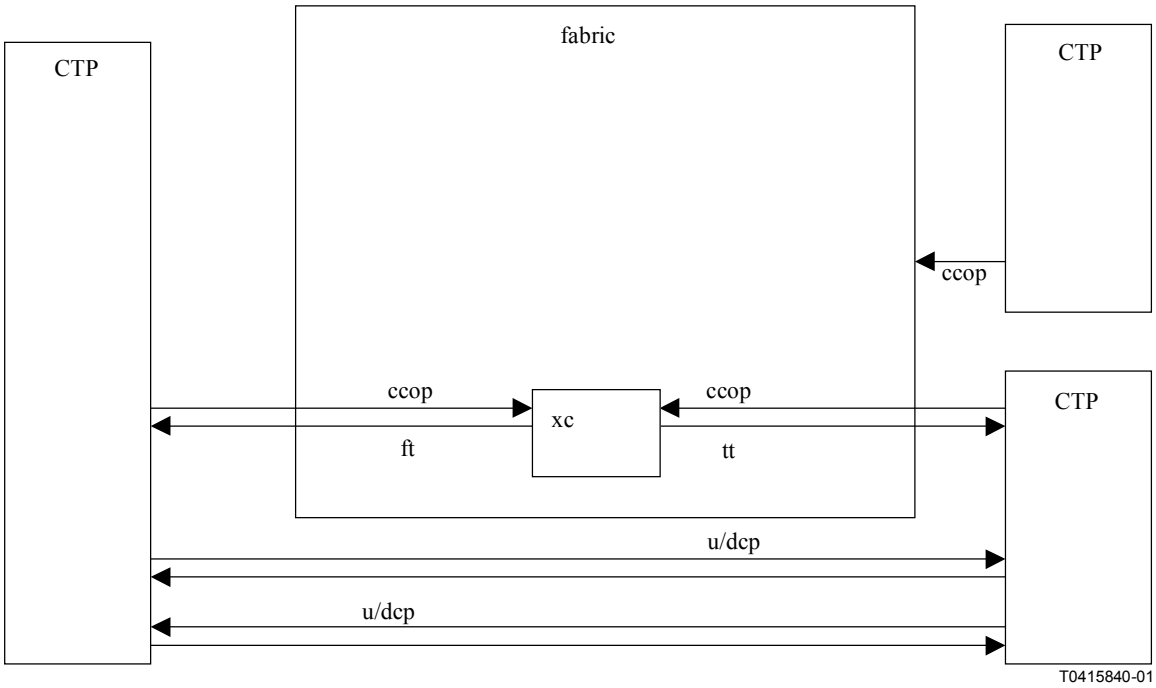

Figure 9/M.3100 – Release bridge operation (point-to-point bidirectional)

5.2 Unidirectional connection

This clause describes the behaviour for unidirectional connections (both point-to-point and multicast) during the bridge and roll procedure. With unidirectional connections, the behaviour is different at each end of the connection. Figure 10 shows a simple unidirectional connection that involves two network elements. For purposes of the discussion that follows, NE1 is called the source end, and NE2 is called the sink end.

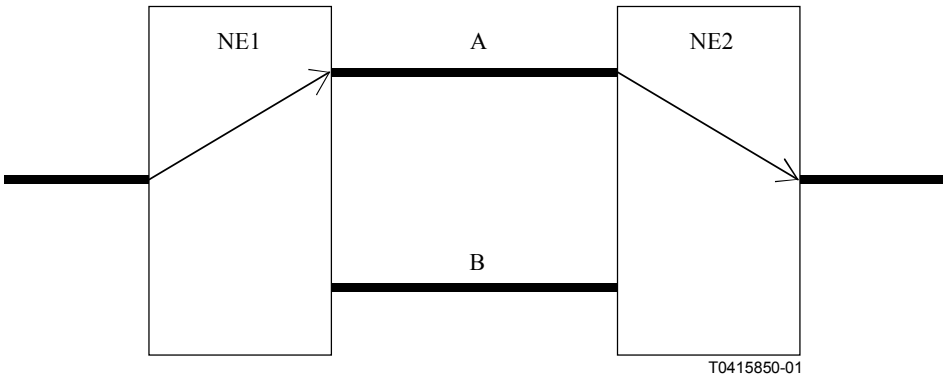

Figure 10/M.3100 – Unidirectional cross-connection

5.3 Source end of unidirectional point-to-point connection

At the source end of a unidirectional point-to-point connection, the roll operation has no meaning, and is thus an optional step in the process (there is no data related to this connection flowing in that direction). The bridge and release bridge operations have the same meaning as they do in the bidirectional point-to-point case.

5.4 Source end of multicast connection

As is the case with the source of a unidirectional point-to-point connection, the roll operation has no meaning, and is optional. Moreover, the bridge operation is really no different than adding a leg to the multicast, and the release bridge operation is no different than removing a leg from the multicast. The bridge and roll process provides those functions for completeness (a typical application is to bridge all connections from one facility to another one, and it is desirable that the manager have a single interface for this application).

5.5 Sink end of unidirectional point-to-point connection or multicast connection

At the sink end of a unidirectional connection, the bridge operation does not cause any change in the flow of traffic. However, it is still important in some network elements to reserve the resources that will be used in the roll operation, thus for some network elements the bridge is a required operation. To enhance interoperability, it is proposed that the bridge request be accepted by all network elements, whether or not resources are reserved. When a network element does reserve resource, it is proposed that this reservation be indicated by pointing the ccop of the termination point to the existing cross-connection.

The roll operation consists of replacing one termination with another (i.e. there is no new cross-connection that gets created in this case), and the release bridge releases the reservation on the resources that are no longer used. This is shown in Figures 11 to 14 that follow (the point-to-point case is shown; the multicast case is very similar).

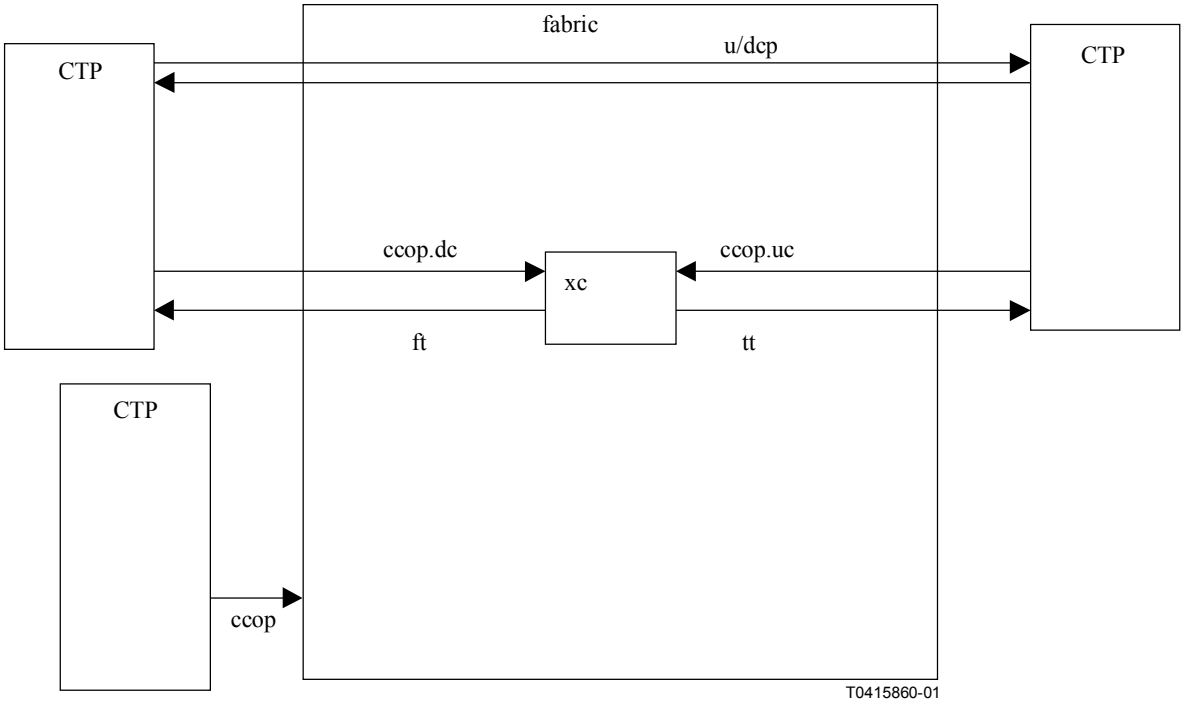

Figure 11/M.3100 – Initial configuration (point-to-point unidirectional sink end)

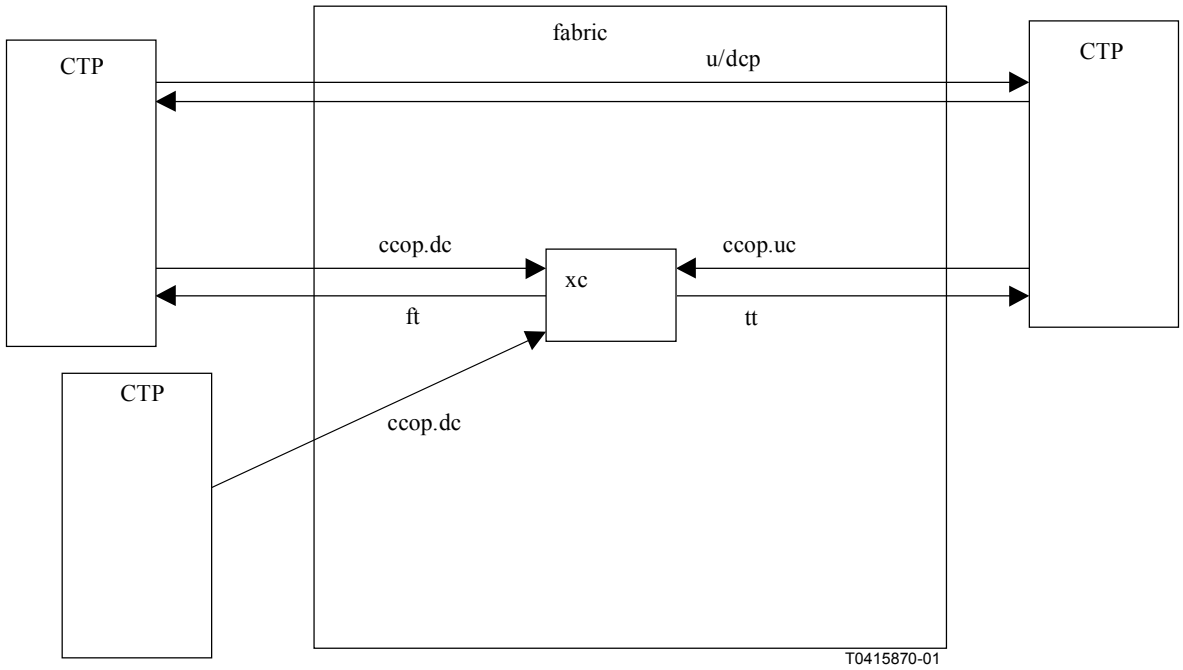

Figure 12/M.3100 – Bridge operation (point-to-point unidirectional sink end)

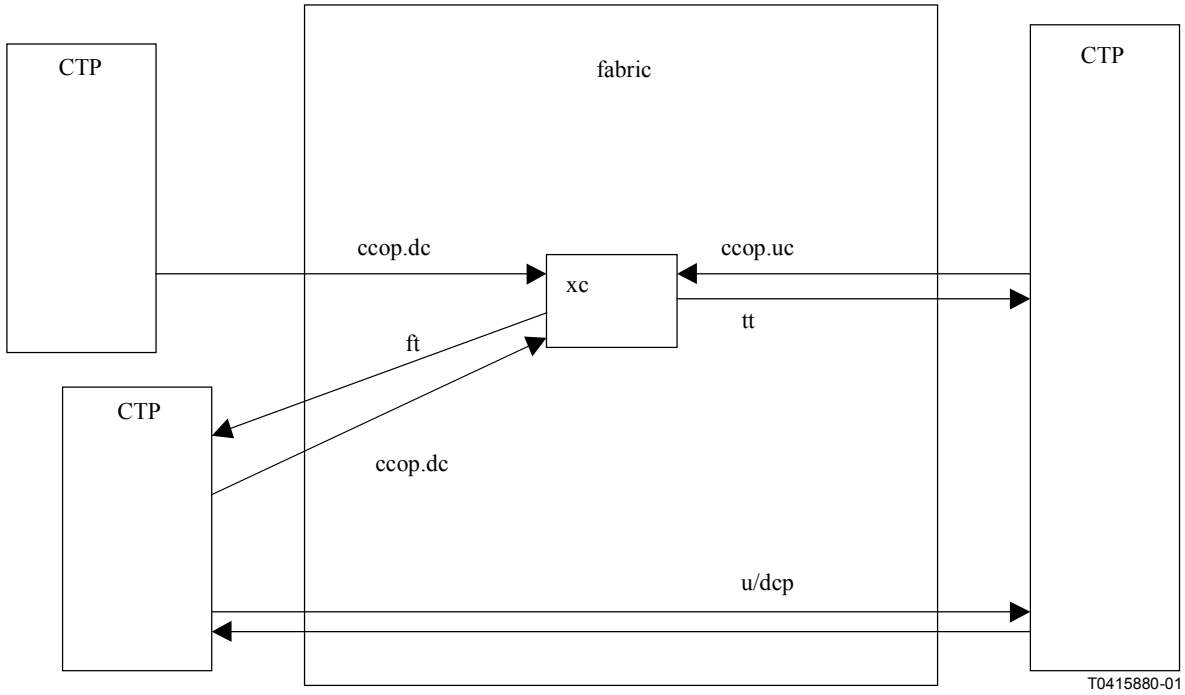

Figure 13/M.3100 – Roll operation (point-to-point unidirectional sink end)

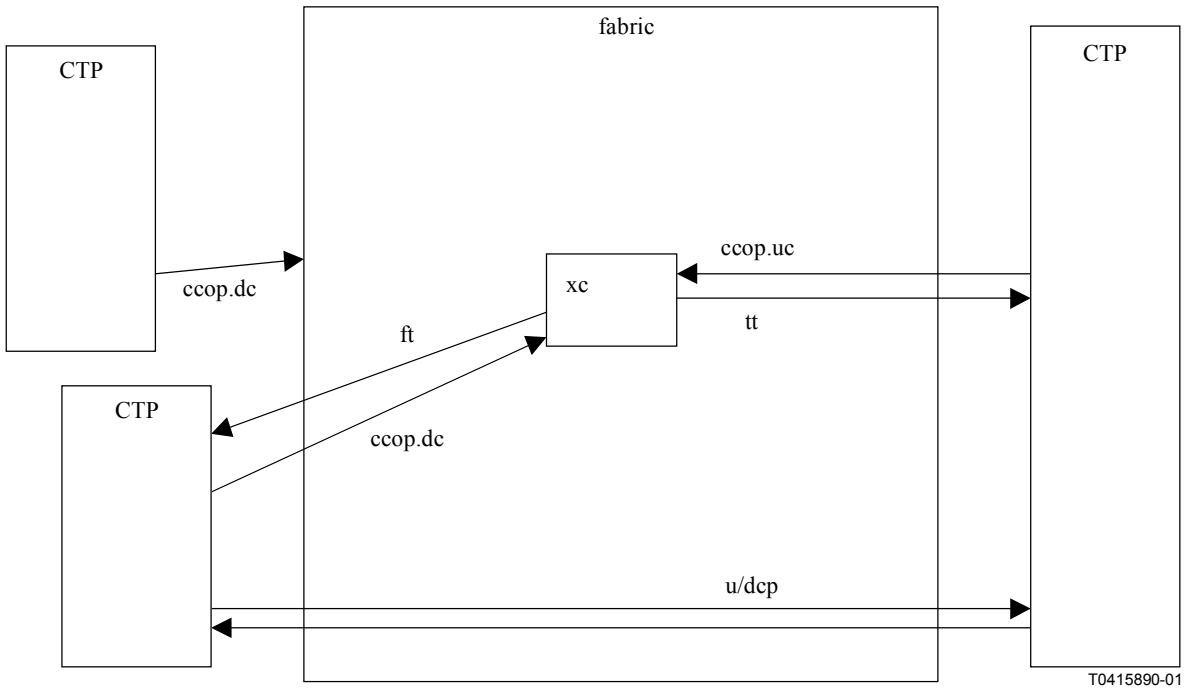

Figure 14/M.3100 – Release operation (point-to-point unidirectional sink end)

5.6 Modeling alternatives

As stated in the introduction, none of the existing standards support a 3-step bridge and roll process.

To support a three-step process, a new fabric object class is needed. There are two alternatives, depending on how important it is to preserve compatibility with the existing models:

- Derive a new fabric from M.3100:fabricR2; this fabric would support a new action that allows either the 2-step or 3-step process.
- Derive a new fabric from X.721:top or M.3100:fabric; this fabric would only support the 3-step process. If a 1- or 2-step process is desirable, the manager can provide such an interface, using the primitives from the 3-step process.

The choice between the two alternatives depends on how important the 2-step process is; if there is a need for an atomic roll and release operation, the first alternative is necessary. If not, the second alternative is perhaps simpler.

6 Design

This clause defines GDMO and CORBA IDL designs (both fine-grained and coarse-grained) for the bridge-and-roll cross-connection.

6.1 GDMO model

This clause defines the new fabric and supporting ASN.1 productions.

6.1.1 fabricR3

```
fabricR3 MANAGED OBJECT CLASS
     DERIVED FROM fabricR2;
     CHARACTERIZED BY fabricR3Pkg PACKAGE
     ACTIONS bridgeRoll;;;
REGISTERED AS { m3100ObjectClass 73 };

bridgeRoll ACTION
     BEHAVIOUR bridgeRollBeh;
     MODE CONFIRMED;
     WITH INFORMATION SYNTAX M3100ASN1TypeModule5.BridgeRollArg;
     WITH REPLY SYNTAX M3100ASN1TypeModule5.BridgeRollReply;
REGISTERED AS { m3100Action 22 };

bridgeRollBeh BEHAVIOUR
     DEFINED AS
          "This action is used to control the bridge and roll process. This
          process is used to move a signal from one leg of an existing cross-
          connection to new leg.
          The results of a bridge and roll operation take one of two forms:
          bridgeRollFailed, which indicates that the requested operation was not
          successful. This response uses the same logicalProblems as the connect
          action of the fabric to report problems with the creation of a bridge.
          When the requested action cannot be performed because the identified
          termination points are not part of the connection, the logicalProblem
          notAlreadyConnected is used.
          bridgeRollComplete, which indicates that the requested operation was
          successful.

          For a bridge operation, the manager must specify the affected cross-
          connection, the termination point of that cross-connection that is to
          be replaced (bridgeRollFromTp), and the new termination point that will
          replace it (bridgeRollToTp). The results of the bridge operation depend
          on the type of cross-connection:
          if the connection is bidirectional, or the connection is unidirectional
          point-to-point and the bridgeRollFromTp is the toTermination of the
          crossConnection, the bridge operation will bridge the signal to the new
          leg, causing the creation of a new one-way crossConnection. If the
          operation is successful, the bridgeRollComplete field indicates the
          newly created crossConnection.
```

if the connection is unidirectional point-to-multipoint, and the bridgeRollFromTp is the toTermination of the crossConnection, the bridge operation will result in the addition of another leg to the multicast. If the operation is successful, the bridgeRollComplete field indicates the newly created crossConnection.
if the connection is unidirectional (point-to-point or point-to-multipoint), and the bridgeRollFromTp is the fromTermination of the connection, the bridge operation will reserve the bridgeRollToTp for use (if the network element supports such resource reservation), but will not cause a new connection to be created; the reservation is indicated by pointing the crossConnectionObjectPointer of the bridgeRollToTp to the existing crossConnection or mpCrossConnection object instance. If the operation is successful, the bridgeRollComplete field is NULL.

For a roll operation, the manager must specify the same cross-connection and termination points that were specified in the bridge operation. The bridgeRollFromTp identifies the termination point from which service will be rolled. The results of a roll operation depend on the type of connection:
If the connection is bidirectional, the crossConnection associated with the bridgeRollFromTp is made unidirectional, and the crossConnection associated with the bridgeRollToTp is made bidirectional. If the operation is successful, the bridgeRollComplete field is NULL.
If the connection is unidirectional (point-to-point or point-to-multipoint), and the bridgeRollFromTp is the toTermination of the connection, there is no change to the configuration. If the operation is successful, the bridgeRollComplete field is NULL.
If the connection is unidirectional (point-to-point or point-to-multipoint), and the bridgeRollFromTp is the fromTermination of the connection, the fromTermination of the connection is changed from the bridgeRollFromTp to the bridgeRollToTp. If the operation is successful, the bridgeRollComplete field is NULL.

For a releaseBridge operation, the manager must specify the same cross-connection and termination points that were specified in the bridge operation. The bridgeRollFromTp identifies the termination point that is to be removed from the cross-connection. The results of a releaseBridge operation depend on the type of connection:
If the connection is bidirectional, or the connection is unidirectional (point-to-point or point-to-multipoint) and the bridgeRollFromTp is not the toTermination of the connection, the releaseBridge operation causes the crossConnection that is associated with the bridgeRollFromTp to be deleted. If the operation was successful, the bridgeRollComplete field indicates the crossConnection that was deleted.
If the connection is unidirectional (point-to-point or point-to-multipoint) and the bridgeRollFromTp is reserved by the connection, but is not the fromTermination of the connection, the releaseBridge operation causes the bridgeRollFromTp to be unreserved; this is indicated by pointing the crossConnectionObjectPointer of that termination point to the fabric. If the operation was successful, the bridgeRollComplete field is NULL."

6.1.2 Supporting productions

```
M3100ASN1TypeModule5 {itu-t recommendation m gnm(3100) informationModel(0)
asn1Modules(2) asn1Module5(4) }
DEFINITIONS IMPLICIT TAGS ::=
BEGIN
-- EXPORTS everything
IMPORTS
     ObjectInstance FROM CMIP-1 {joint-iso-itu-t ms(9) cmip(1) modules(0)
     protocol(3) }
```

```
    ManagementExtension, AdditionalInformation FROM Attribute-ASN1Module
    { joint-iso-ccitt ms(9) smi(3) part2(2) asn1Module(2) 1}

    Failed, PointerOrNull FROM ASN1DefinedTypesModule {ccitt recommendation m
    gnm(3100) informationModel(0) asn1Modules(2) asn1DefinedTypesModule(1) };

BridgeRollArg ::= SEQUENCE OF SEQUENCE {
    xc                  ObjectInstance,
    bridgeRollFromTp    ObjectInstance,
    bridgeRollToTp      ObjectInstance,
    bridgeRollOperation ENUMERATED {
                  bridge             (0),
                  roll               (1),
                  releaseBridge      (2),
                  ... },
    additionalInfo SET OF ManagementExtension OPTIONAL
}

BridgeRollReply ::= SEQUENCE OF CHOICE {
    bridgeFailed            [0]  Failed,
    bridgeRollResult        [1]  PointerOrNull
}

END
```

6.2 CORBA model

```
#ifndef _itut_m3120_bridge_and_roll_idl_
#define _itut_m3120_bridge_and_roll_idl_

#include <itut_m3120.idl>

#pragma prefix "itu.int"


/**
This fabric fragment is added to the itut_m3120 module that contains IDL
definition based on objects defined in M.3100 and G.855.1.

*/

/**
The IDL code contained in this fragment is intended to be stored in a file named
"itut_m3120_bridge_and_roll.idl" located in the search path used by the IDL
compilers on your system. The M.3120 main module (defined in M.3120) is contained
in a separate file "itut_m3120.idl".
*/

module itut_m3120
{
/**
```

6.2.1 Imports

```
*/

typedef itut_x780::ManagementExtensionType ManagementExtensionType;

/**
```

6.2.2 Structures and typedefs

```
*/

enum BridgeRollOperationType
{
     brOperationBridge,
     brOperationRoll,
     brOperationReleaseBridge
};

typedef sequence<ManagementExtensionType> ManagementExtensionSetType;

/**
ManagementExtensionSetTypeOpt is an optional type. If the discriminator is true
the value is present, otherwise the value is nil.
*/
union ManagementExtensionSetTypeOpt switch (boolean)
{
     case TRUE:
          ManagementExtensionSetType   val;
};

struct BridgeRollArgElementType
{
     MONameType                        xc;
     MONameType                        bridgeRollFromTp;
     MONameType                        bridgeRollToTp;
     BridgeRollOperationType           bridgeRollOperation;
     ManagementExtensionSetTypeOpt     additionalInfo;
};

typedef sequence<BridgeRollArgElementType> BridgeRollArgSeqType;

enum BridgeRollReplyElementChoice {
    bridgeFailed,
    bridgeRollResult
};

union BridgeRollReplyElementType switch (BridgeRollReplyElementChoice)
{
    case bridgeFailed:      FailedType          failedValue;
    case bridgeRollResult:  MONameType     pointerOrNullValue;
};

typedef sequence<BridgeRollReplyElementType> BridgeRollReplySeqType;

/**
```

6.2.3 Interfaces – Fine-grained

```
*/

/**
```

6.2.3.1 Fabric R3

```
This interface supports the FabricR3 with bridge-and-roll capability.

*/
     valuetype FabricR3ValueType: FabricValueType {

     }; // valuetype FabricR3ValueType
```

```
     interface FabricR3: Fabric
     {

/**
See 4.1.1 for the behaviour of the FabricR3 object class.
*/
          void bridgeRoll
               (in BridgeRollArgSeqType request,
               out BridgeRollReplySeqType result)
               raises (itut_x780::ApplicationError);

     }; // interface FabricR3

     interface FabricR3Factory: itut_x780::ManagedObjectFactory
     {
          itut_x780::ManagedObject create
               (in NameBindingType nameBinding,
               in MONameType superior,
               in string reqID,   // auto naming if empty string
               out MONameType name,
               in StringSetType packageNameList,
               in MONameSetType supportedByObjectList,
                    // may be empty set type
                    // fabricPackage
                    // GET-REPLACE, ADD-REMOVE
               in CharacteristicInfoSetType characteristicInfoList,
                    // fabricPackage
                    // GET, SET-BY-CREATE
               in AdministrativeStateType administrativeState)
                    // fabricPackage
                    // GET-REPLACE
               raises (itut_x780::ApplicationError,
                    itut_x780::CreateError);

     }; // interface FabricR3Factory


/**
```

6.2.4 Interfaces – Facade

```
*/

/**
```

6.2.4.1 Fabric R3 facade

```
This interface supports the FabricR3 facade with bridge-and-roll capability.

*/

     interface FabricR3_F: Fabric_F
     {
          void bridgeRoll
               (in  MONameType              name,
               in   BridgeRollArgSeqType    request,
               out  BridgeRollReplySeqType  result)
               raises (itut_x780::ApplicationError);

     }; // interface FabricR3_F


}; // module itut_m3120

#endif // _itut_m3120_bridge_and_roll_idl_
```

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