



(11) (21) (C) **2,180,518**
(22) 1996/07/04
(43) 1997/11/24
(45) 2000/12/05

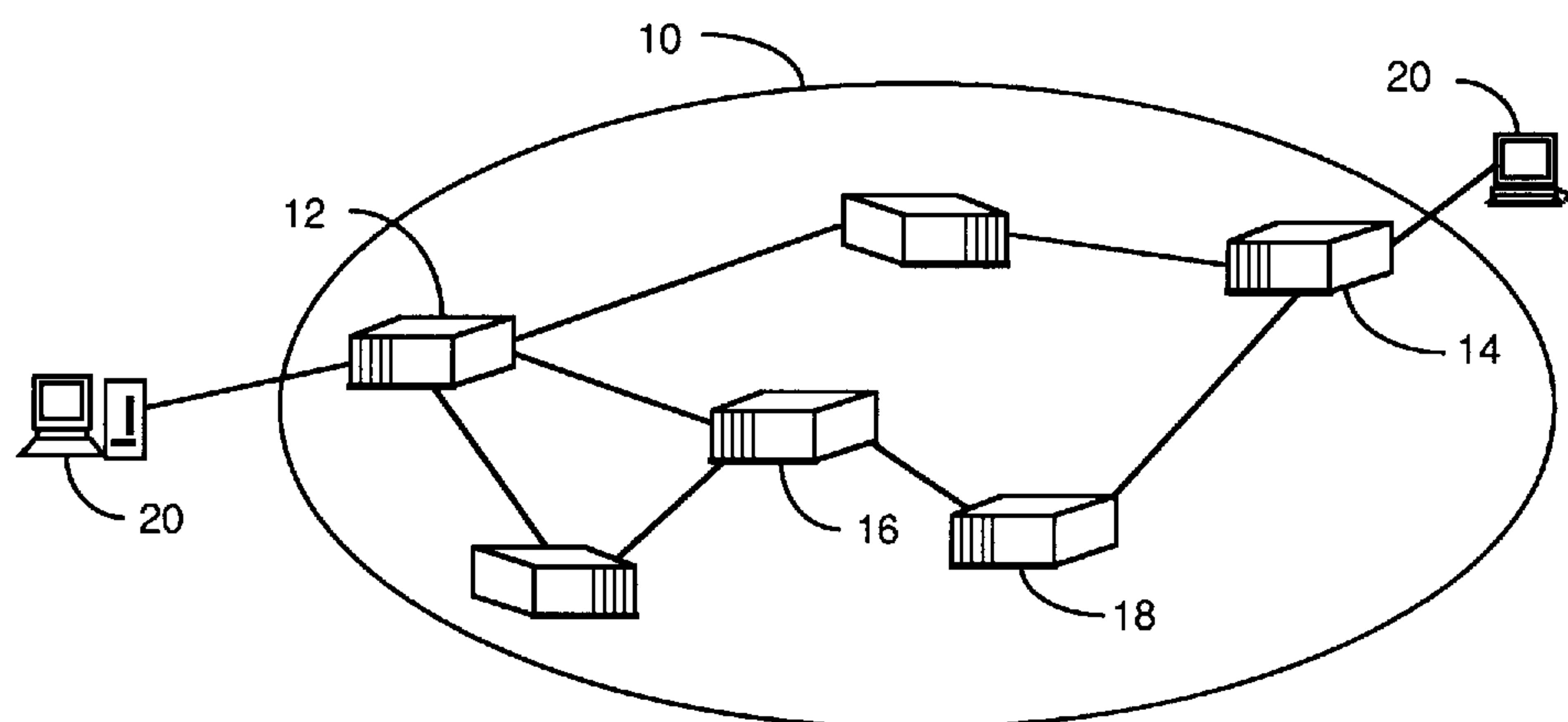
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(51) Int.Cl.⁶ H04L 12/56

(30) 1996/05/23 (08/652,061) US

(54) **MECANISME DE BOUCLAGE POUR RELAIS DE TRAME**

(54) **LOOPBACK MECHANISM FOR FRAME RELAY OAM**



(57) Mécanisme de bouclage utilisant des relais répartiteurs de bouclage en méthode d'accès objet, ce qui élimine la nécessité d'identificateurs d'emplacement et réduit les frais généraux et la complexité. Les répartiteurs remplacent les identificateurs d'emplacement d'origine et les identificateurs de destination par un champ indicateur de bouclage, un champ de comptage de noeud de transmission, et un champ de comptage de noeud de retour. Le noeud d'origine de la procédure de bouclage établit le nombre de noeuds de relais de répartiteur intermédiaire devant être franchis. Les noeuds de relais de répartiteur intermédiaire incrémentent ou décrémentent tout simplement le nombre de noeuds, suivant la direction du répartiteur de bouclage.

(57) A loopback mechanism uses frame relay OAM loopback frames which eliminate the need for location identifiers and reduces overhead and complexity. The frames replace source and destination loopback location identifiers by a loopback indicator field, a send node count field and a return node count field. The originating node of the loopback procedure sets the number of intermediate frame relay nodes to be traversed. The intermediate frame relay nodes simply increment or decrement the node count, depending on the direction of the loopback frame.



LOOPBACK MECHANISM FOR FRAME RELAY OAM

Abstract of the Disclosure

A loopback mechanism uses frame relay OAM loopback frames which eliminate the need for location identifiers and reduces overhead and complexity. The frames replace source and destination loopback location identifiers by a loopback indicator field, a send node count field and a return node count field. The originating node of the loopback procedure sets the number of intermediate frame relay nodes to be traversed. The intermediate frame relay nodes simply increment or decrement the node count, depending on the direction of the loopback frame.

LOOPBACK MECHANISM FOR FRAME RELAY OAM

Field of Invention

The invention relates generally to a frame relay OAM procedure. In particular, it is directed to a simplified mechanism for the frame relay OAM loopback procedure which reduces overhead in OAM frames and complexity in frame processing.

Background of Invention

It is widely recognized that the use of a simple loopback (LB) function provides necessary OAM capability for fault location, continuity verification, as well as round trip delay (RTD) measurements. It was agreed in the ITU study group to include this function for the future enhancement of frame relay service (FRS) in draft Recommendation I.620. However, the previously proposed LB mechanism in I.620 was analogous to that selected specifically for ATM networks and is not suitable for frame relay (FR) requirements in terms of complexity and overhead.

The OAM LB function for FR needs to be simple and introduce minimum additional processing and bandwidth overhead. However, it should also be flexible to enable additional functionality to be incorporated as required for specific OAM applications. The present invention solves these problems by simplifying the LB OAM procedure, is more efficient than the existing procedure and should be more suitable for the enhancement of future FRS.

Objects of Invention

It is therefore an object of the invention to provide a loopback mechanism for FRS which is simpler and more efficient, requiring less processing.

It is another object of the invention to provide a loopback mechanism for FRS which is more flexible for future enhancement of FRS.

Summary of Invention

Briefly stated, according to one aspect, the invention is directed to a method of performing a loopback function in a telecommuni-

cations network. The method comprises a step of the source node sending an FR OAM frame towards a loopback node, the FR OAM frame having a loopback indicator field set to sending, a send node count field set to the number of intermediate frame relay nodes, and a
5 return node count field set to a predetermined value. The method further includes steps of the intermediate frame relay nodes successively incrementing the return node count field when the loopback indicator field is set to sending and forwarding the FR OAM frame downstream; and on the condition that the values of the send
10 node count field and return node count field meet certain criteria, the loopback node looping back to the source node the FR OAM frame which has the loopback indicator field set to loopback.

Brief Description of Drawings

15 Figure 1 is a schematic illustration of a telecommunication network which is performing FRS between a source node and a destination node;

Figure 2 shows an OAM frame which the ITU-T Study Group 13 attempted to use for loopback services; and

20 Figure 3 shows an FR OAM loopback frame format according to one embodiment of the invention.

Detailed Description of Preferred Embodiments of Invention

Figure 1 shows schematically a telecommunication network 10
25 which is holding a connection for FRS between two end nodes 12 and 14. Also shown are a few intermediate FR nodes 16 and 18. End users 20 are also shown as accessing the end nodes. In order to manage FRS properly, nodes periodically, or from time to time, exchange specially designed frames called FR OAM frames. Any FR node can be
30 configured by the management interface to be a participating or a non-participating node for the purposes of the FR LB OAM test.

Figure 2 is an ATM OAM cell which includes such fields as a loopback location and source ID fields. Previously the ITU-T Study Group 13 proposal for FR OAM attempted to use OAM frames which
35 were of similar structure as shown in Figure 2. However, this mechanism was found to be too complex for FR OAM requirements.

According to one embodiment of the invention, the LB procedure for FRS can be considerably simplified and overhead reduced by replacing the source and destination LB location identifiers (currently 16 octets each) with a "hop count" mechanism.

5 Figure 3 is an FR OAM loopback frame format suitable for the embodiment of the invention.

Correlation Tag (CT): 7 bits

10 This field is used to correlate the transmitted LB frame with the received LB frame, in conjunction with the Return Node Count value (see below).

Loopback Indicator (LBI): 1 bit

15 This field provides a Boolean indication as to whether or not the frame has been looped back (Send or Return direction indication). In one embodiment, for a send frame the LBI is set to 1. For a return frame the LBI is set to 0.

Send Node Count (SNC): 1 octet

20 This field is set by the sending node to indicate the number of FR nodes to be traversed before loopback. If the SNC is set to 0, the LB frame should be passed by every node to the connection end point for initialization purposes as described below. If the SNC is set to all-ones, the LB frame should be passed by every node to the connection end
25 points for the specific case of an end-to-end loopback.

Return Node Count (RNC): 1 octet

30 The Return Node Count value is incremented by 1 by each FR node traversed if the LBI is set to 1. The RNC value is decremented by 1 by each FR node traversed when the LBI is set to 0.

Time Stamp (TS). Optional. Variable Length

35 This field may be used to encode a time stamp for Round Trip Delay (RTD) measurements. The format and encoding of the TS field is in accordance with the ASN.1 notation for Type-Length-Value (TLV).

Additional Function Specific Field(s) (FSF): Optional. Variable Length
The format of this field is in accordance with the ASN.1 notation for
TLV as for TS. This field(s) may be used for enhancement of other
OAM functions such as QOS monitoring etc. and may be

5 implementation specific. This field(s) may be used for additional OAM
functions.

Initialization Procedure

Any FR node may determine the number of nodes upstream
10 and downstream for LB purposes by using the Send and Return Node
Counts as follows:

The FR node sends the LB frame with SNC=0. LB frames with
SNC=0 are used for initialization purposes only and are called
Initialization Loopback (ILB) frames. Every FR node passes this frame
15 after incrementing the value of the RNC field by 1 if the LBI is set to 1
(send direction). The connection end point copies the RNC value to
the SNC field and sets LBI to 0 before looping back the ILB frame. In
the return direction, each node decrements the RNC value by 1 as per
the normal procedures described below. The originating node extracts
20 the ILB frame on the condition RNC=0. The value in the SNC field is
then the number of nodes in the connection (for the given direction).

For the specific case of end-to-end loopback (SNC=all-ones), the
initialization procedure need not be used.

25 Loopback Procedure

The loopback mechanism according to one embodiment will be
described in detail below.

Once the FR node has determined the number of participating
nodes involved in the connection using the above initialization
30 procedure in each direction, LB procedures for either end-to-end or
segment can proceed normally as follows:

- (1) The source node sets the value of the SNC field to the required
number of nodes to be traversed before loopback (the LB node).
The LBI is set to 1 and a valid correlation tag value (e.g. sequence
35 number) is inserted in the CT field. The RNC is set to 0.
- (2) Each node traversed increments the RNC by 1 when the LBI is set
to 1.

(3) The condition $SNC=RNC$ determines the loopback point. The LB node sets the LBI to 0 before looping back the LB frame. The LB frame may be copied for subsequent processing of the function specific fields by the management system.

5 In the return direction ($LBI=0$), each node decrements the RNC value by 1. The condition $RNC=0$ identifies the originating node. The originating node extracts (or copies) the LB frame for processing by the management system.

10 For the specific case of end-to-end loopback, the originating end-point (source node) sets the SNC to all-ones; other procedures are the same as in the general case.

15 Loopback procedures can be initiated by management action on demand, or by end users as required. Loopback frames may be sent periodically if required. The period is under management control and depends on service requirements.

20 It should be noted that specific values described above are in connection with one of the embodiments only. There are many values and relationships between some values that can be employed depending upon the operational conditions.

Non-participating Nodes

25 As described earlier, any FR node may be configured by the management interface to be a participating or a non-participating node for the purposes of the FR LB OAM test. In the case that the node is considered to be non-participating in the LB test, it is required to transparently pass the LB OAM frames. Changes in configuration will require that the ILB frame be used to determine the new number of participating nodes in the connection.

30

LBI Error Condition

35 In the event that an LB point does not set the $LBI=0$ (e.g. as an error condition), the RNC values in the return direction will continue to be incremented, resulting in the originating point not extracting the LB frame. However, in this case, the downstream FR connection end point node will discard the LB frame when it detects the condition where $LBI=1$ and SNC is not equal to RNC .

WHAT IS CLAIMED IS:

1. A method of performing a loopback function for frame relay services in a telecommunications network which contains one or more intermediate frame relay nodes,
5 comprising steps of:

a source node sending a frame relay operation administration maintenance frame, hereinafter called FR OAM frame, towards a loopback node, the FR OAM frame having a loopback indicator field set to sending, a send node count field set to the number of intermediate frame relay nodes and a return node count field set to a predetermined value;

10 the intermediate frame relay nodes successively incrementing the return node count field when the loopback indicator field is set to sending and forwarding the FR OAM frame downstream; and

on the condition that the values of the send node count field and return node count field meet certain criteria, a loopback node setting the loopback indicator field to
15 loopback and looping back to the source node the FR OAM frame.

2. In a telecommunications network which is holding a connection between a source node and a destination node for frame relay services, the connection containing one or more intermediate frame relay nodes, a method of performing a loopback function
20 comprising steps of:

the source node sending an FR OAM frame towards the loopback node, the FR OAM frame having a loopback indicator field set to sending, a send node count field set to the number of intermediate frame relay nodes and a return node count field set to a predetermined value;

25 the intermediate frame relay nodes successively incrementing the return node count field when the loopback indicator field set to sending and forwarding the FR OAM frame downstream; and

on the condition that the values of the send node count field and return node count field meet certain criteria, a loopback node looping back to the source node the FR OAM
30 frame which has the loopback indicator field set to loopback.

3. The method according to claim 2, further comprising steps of the intermediate frame relay nodes forwarding the FR OAM frame towards the source node when the loopback indicator field is set to loopback, after having decremented the return node count field.

5

4. The method according to claim 3, further comprising steps of the source node sending an initialization FR OAM frame towards the loopback node, the initialization FR OAM frame having the source node count field set to a predetermined value.

10

5. The method according to claim 3, further comprising steps of:

the source node sending an end-to-end loopback frame, the end-to-end loopback frame having the send node count field set to a particular value; and

the destination node looping back to the source node the end-to-end loopback frame, which has the loopback indicator field set to loopback.

15

6. In a telecommunications network which is holding a connection between a source node and destination node for frame relay services, the connection containing one or more intermediate frame relay nodes, a method of performing a loopback function comprising steps of:

20

the source node sending an FR OAM frame towards the destination node, the FR OAM frame having a loopback indicator field set to sending, a send node count field set to the number of intermediate frame relay nodes and a return node count field set to 0;

the intermediate frame relay nodes successively incrementing the return node count field by one when the loopback indicator field is set to sending and forwarding the FR OAM frame downstream towards the destination node; and

25

on the condition that the send node count field value equal to the return node count field value, the destination node looping back to the source node the FR OAM frame which has the loopback indicator field set loopback.

30

7. The method of performing a loopback function according to claim 6 further comprising steps of:

the source node sending an FR OAM initialization frame towards the destination node, the FR OAM initialization frame having a loopback indicator field set to sending, a send node count field set to 0 and a return node count field set to 0; and

the destination node copying the value of the send node count field and looping back to the source node the FR OAM initialization frame which has the loopback indicator field set to loopback.

8. The method of performing a loopback function according to claim 6 further comprising steps of:

the source node sending an end-to-end loopback frame, the end-to-end loopback frame having the send node count field set to all ones; and

the destination node looping back to the source node the end-to-end loopback frame, which has the loopback indicator field set to loopback.

9. In a telecommunications network which is holding a connection containing a source node and N intermediate frame relay nodes, N being any positive integer, a method of performing a loopback function on the connection comprising steps of:

the source node sending an FR OAM frame downstream of the connection, the FR OAM frame having a loopback indicator field set to sending, a send node count field set to N and a return node count field set to a predetermined value;

the FR OAM frame which is to indicate each intermediate frame relay node to increment the return node count field by one and forward the FR OAM frame downstream if the loopback indicator field is set to sending, to decrement the return node count field by one and forward the FR OAM frame upstream towards the source node if the loopback indicator field is set to loopback and is further to indicate a loopback node to loopback the FR OAM frame by setting the loopback indicator field to loopback on the condition that the values of the send node count field and return node count field meet certain criteria; and

the source node receiving the FR OAM frame which has been looped back on the connection, the received FR OAM frame having the loopback indicator field set to loopback, and the return node count field which has been successively incremented by the intermediate frame relay nodes when the FR OAM frame was being sent downstream and decremented by the intermediate frame relay nodes when the FR OAM frame was being looped back.

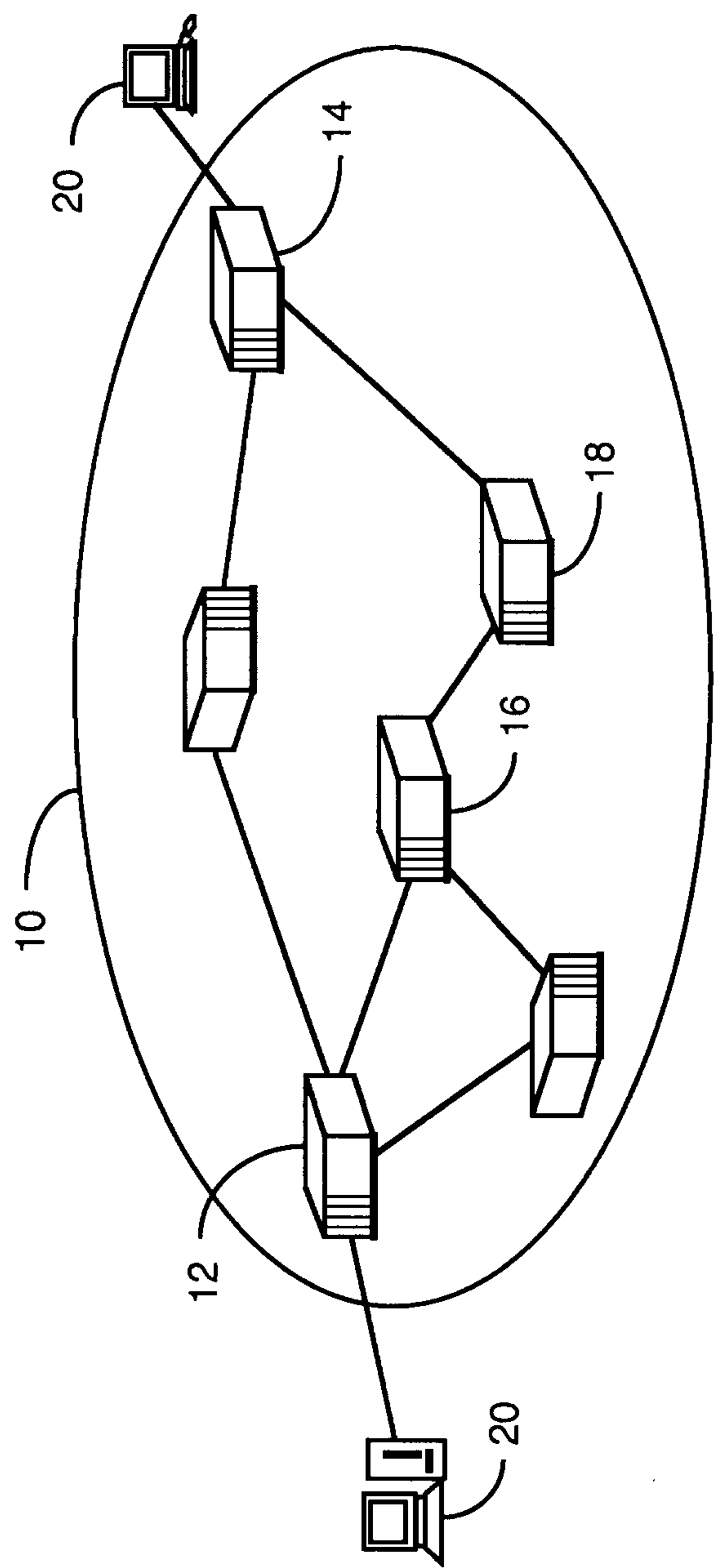


Fig 1

ATM Header	Common Field	Loopback Identification	Correlation Tag	Loopback Location ID	Source ID	Reserved	CRC-16
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Fig 2

Correlation Tag (CT) 7 bits	L	Send Node Count (SNC) 1 octet	Return Node Count (RNC) 1 octet	Time Stamp (TS) (Optional) TLV notation	Additional Function Specific Field(s) (Optional) TLV notation
	B				
	I				

↑
Loopback Indicator (LBI)
1 bit

Fig 3

