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DIGITAL NETWORKS

MANAGEMENT CAPABILITIES OF TRANSPORT NETWORKS BASED ON THE SYNCHRONOUS DIGITAL HIERARCHY (SDH)

ITU-T Recommendation G.831

(Previously "CCITT Recommendation")

FOREWORD

The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the International Telecommunication Union. The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, established the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

ITU-T Recommendation G.831 was prepared by the ITU-T Study Group XVIII (1988-1993) and was approved by the WTSC (Helsinki, March 1-12, 1993).

NOTES

1 As a consequence of a reform process within the International Telecommunication Union (ITU), the CCITT ceased to exist as of 28 February 1993. In its place, the ITU Telecommunication Standardization Sector (ITU-T) was created as of 1 March 1993. Similarly, in this reform process, the CCIR and the IFRB have been replaced by the Radiocommunication Sector.

In order not to delay publication of this Recommendation, no change has been made in the text to references containing the acronyms "CCITT, CCIR or IFRB" or their associated entities such as Plenary Assembly, Secretariat, etc. Future editions of this Recommendation will contain the proper terminology related to the new ITU structure.

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

Recommendation G.831

MANAGEMENT CAPABILITIES OF TRANSPORT NETWORKS BASED ON THE SYNCHRONOUS DIGITAL HIERARCHY (SDH)

(Helsinki, 1993)

1 Introduction

1.1 Scope

This Recommendation is concerned with describing the management requirements of the layered and partitioned transmission networks described in G.803. It is not concerned with the general Telecommunications Management Network (TMN) issues. It is concerned with the definition of the path management process and in particular those aspects which require standards support across administrative domain boundaries.

It is expected to provide a framework for the definition of administrative boundaries in an environment characterized by high levels of functional integration. Such boundaries will not generally coincide with layer boundaries.

1.2 Structure of Recommendation

Clause 2 identifies the categories and goals of the management capabilities of SDH. Clause 3 gives the requirements of access point identifiers and recommends a format for the identifiers. Clause 4 contains information on trail set-up, validation and monitoring.

2 Management capabilities

2.1 Categories of management capability

The SDH will enable a greater degree of automation in the management of transmission networks and of the fabric which supports them. Management capabilities fall broadly into three categories from the viewpoint of standards support. These are:

a) Those capabilities which must be standardized to allow automated interaction between the managed networks of different network operators.

b) Those capabilities which should be standardized to simplify operations within the domain of a single operator who must obtain equipment from different vendors.

c) Those capabilities which may be defined within a single management domain to optimize operations within that domain.

2.2 Management goals of SDH networks

Whilst G.803 is concerned with the architectural aspects of SDH networks from a transport viewpoint, this Recommendation is concerned with the management goals of SDH networks and the facilities that must be provided within such networks to achieve these goals, and not with the structure or design of the management systems themselves.

The management goals of SDH transmission networks can be stated as follows:

i) The capability will be provided to set up Virtual Container-n (VC-n) paths between client access points automatically on request and across operator boundaries. The client will generally be another network layer as defined in G.803 but may, in the case of leased line type services, be an end user.

G.707, G.708 and G.709 presently define path capacities at VC-11, VC-12, VC-2, VC-2-nc, VC-3, VC-4 and VC-4-nc [category a)].

ii) The capability will be provided to maintain these paths to a very high availability restoring failed paths automatically if appropriate to the Quality of Service [category a)].

iii) The capability will be provided to continuously monitor performance of allocated paths, while in service, and validate compliance with service commitments [category a)/b)].

iv) The capability will be provided for simple remote maintenance of the fabric of the network including the identification and location of faulty equipment [category b)] within an operator domain and [category a)] at operator domain boundaries).

v) The capability will be provided to generate resource utilization information to support routing and billing between operators [category a)] and to support planning and cost accounting within a domain [category b) or c)].

vi) The capabilities will be provided to support a range of ancillary management functions such as inventory, planning, etc. [category [c)].

3 SDH access point identification

An essential requirement for successful path set-up is a unique means of identifying the access points. The following are the features of the access point identifiers:

- each access point identifier must be globally unique in its layer network;
- where it may be expected that the access point may be required for path set-up across an inter-operator boundary, the access point identifier must be available to other network operators;
- the access point identifier should not change while the access point remains in existence;
- the access point identifier should be able to identify the country and network operator which is responsible for routing to and from the access point;
- the set of all access point identifiers belonging to a single administrative layer network should form a single access point identification scheme;
- the scheme of access point identifiers for each administrative layer network can be independent from the scheme in any other administrative layer network.

It is recommended that the VC-11, VC-12, VC-2, VC-3 and VC-4 should each have an independent access point identification scheme based on the format given in Recommendation E.164. The coding and location of the access point identifiers is given in G.709. The suitability of a similar access point identification scheme for the multiplex section and regenerator section layers is under study.

NOTE – E.164 also describes the numbering scheme for the ISDN which is independent of any of the schemes used for the SDH administrative layer networks.

4 SDH trail set-up, validation, monitoring, protection and restoration

4.1 Introduction

Within an SDH administrative layer network, the primary management functions are to set-up, validate, and monitor trails and protect or restore them if necessary. These management functions may be implemented in different ways by network operators. However, the following recommendations ensure that these management functions work successfully in the inter-operator environment.

In general, each administrative path layer network is intended to be global with the possibility of establishing a trail between any two access points in that layer. Each administrative path layer requires a significant path set-up control system capable of working in the global, multi-operator context.

In general, each administrative section layer will not require the ability to connect any one access point to any other access point as the requirement on connectivity will be restricted by the availability of transmission media to the distant location. Each administrative section layer is unlikely to require a significant control system and is intended to require only a simple protocol.

4.2 Trail set-up

4.2.1 General path set-up control structure

Figure 4-1 illustrates the general control structure and information flows necessary for multi-operator path set-up. The control structure is characterized by processing functions and messaging between the processing functions. There are two basic types of messaging.

- messaging between levels of the control structure which pass information between a controlling process in the upper level and the controlled lower level;
- messaging within a level between the peer processing functions within a control level.

The control structure may be implemented in many ways and the structure shown in Figure 4-1 illustrates only essential information flows. If, however, this information flow crosses an external interface, it will use either a standard or proprietary protocol.

4.2.1.1 Inter-operator path set-up

In general, each network operator will have its own management and control system which will interact on a peer basis with that of other operators. The protocol between these control systems must be standard for each administrative path layer to enable inter-operator path set-up. Two possibilities for this protocol are a step-by-step routing protocol of the type used by signalling systems or the source routing protocol of the type described in Standard ISO 8473. Step-by-step routing is a special case of source routing.

4.2.1.2 Intra-operator path set-up

Within the network of a single operator, there is considerable freedom in the choice of system architecture for path set-up. Three basic types are described below:

a) *Centralized intra-operator path set-up* – This makes use of a single central processing facility in which all messaging is internal to the facility other than the final messages to the network elements. The messages to the network elements are described in Recommendations M.3010 and G.774. This is illustrated in Figure 4-2.

b) *Step-by-step routing intra-operator path set-up* – This makes use of step-by-step routing protocols common to many existing signalling systems. In this case the peer messaging may be standardized and could use the same protocol as used for the inter-operator messaging. The control messaging between the levels is internal to the processing facility. The processing facilities may be remote from the network elements in which case the messages described in Recommendations M.3010 and G.774 should be used. However, as the implementation is distributed, the processing facility could be incorporated in the network element in which case the messaging to the network element is internal. This is illustrated in Figure 4-2.

c) *Source routing intra-operator path set-up* – This makes use of a source routing protocol of the type described in Standard ISO 8473. In this case the the complete route across the sub-network is decided at the first node and the message with the remote lower level control is external. The source routing cannot determine the route beyond the sub-network and step-by-step routing must be used at this point. If the protocol used for inter-operator path set-up is capable of source routing, that protocol could be used. This messaging may be standardized and will have similar semantics to the messaging with the network elements. The messaging with the local lower level controller may be internal. If this controller resides inside a network element, the messaging with the network element will be internal. If the controller is remote from the network element, then the messaging described in Recommendations M.3010 and G.774 should be used. This is illustrated in Figure 4-2.

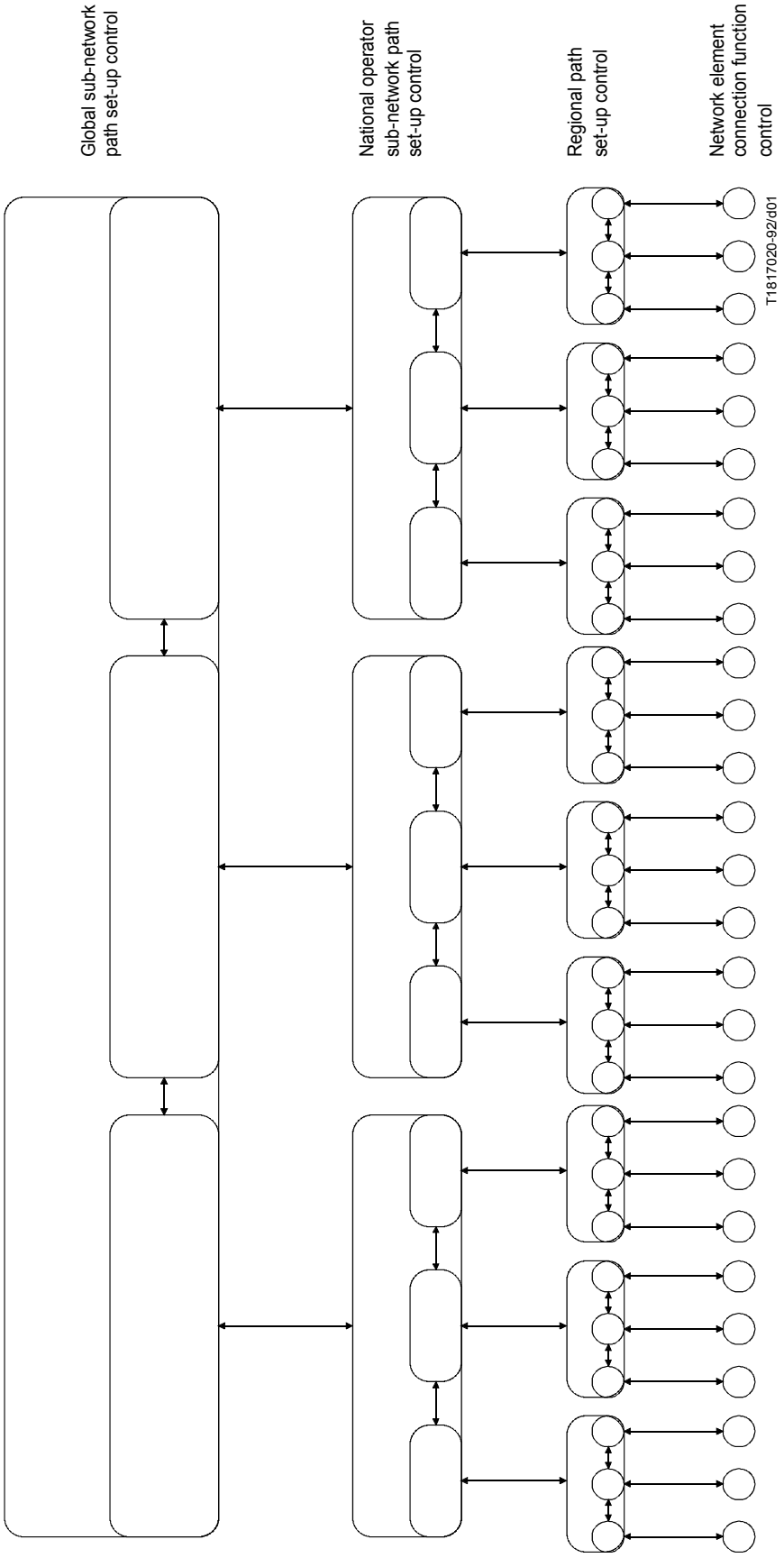

FIGURE 4-1/G.831

Control structure for path set-up

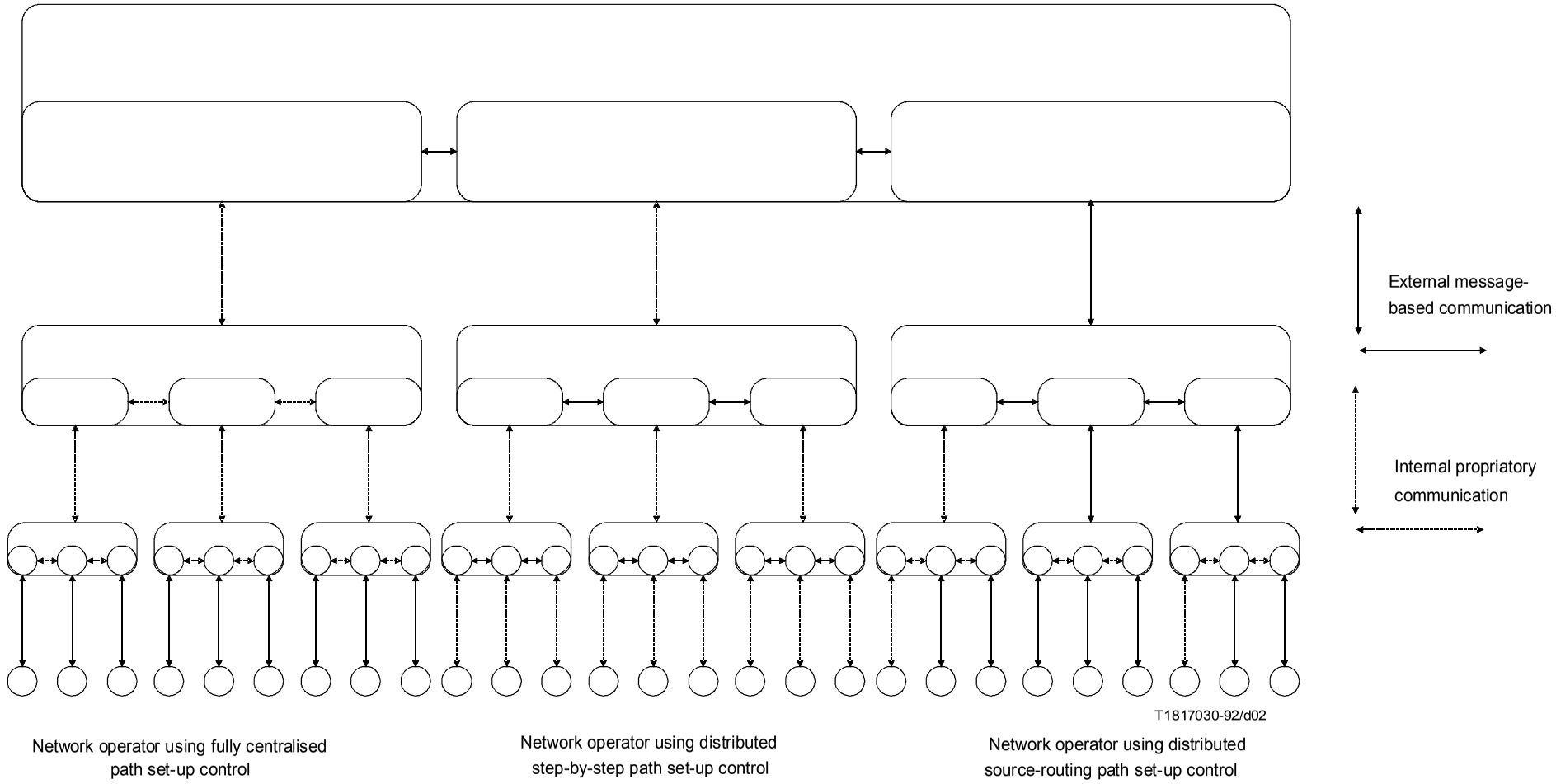

FIGURE 4-2/G.831

Examples of specific path set-up control structures

4.2.2. Section set-up

Section set-up is likely to require human action on fibre distribution frames and/or digital distribution frames. The data base required for this is not directly associated with the frame as the frame has no management interface. For this reason, there is no restriction on the location of any system controlling the section set-up.

4.3 SDH trail validation

Once the path or section has been set up, it should be validated that the correct access points have been connected. For every SDH administrative layer, the access code identifier should be sent in the in-band trail trace channel and validated by the far end. When the path or section is bi-directional, the validation should be done in both directions of transmission.

4.4 SDH trail monitoring

When the path or section has been set-up and validated, it should be continuously monitored for integrity of transmission using the appropriate path overhead or section overhead and should be continuously compared to a threshold. If the performance falls below this threshold a defect is declared. In addition, the actual performance can be periodically reported to a management system. A tandem connection part of the path or section may be monitored as well as the end-to-end path or section by any one of the four methods described in G.803.

4.5 SDH trail protection and restoration

If a defect is declared on a protected end-to-end path or section, then action may be taken to re-establish its integrity. This will involve either protection or restoration procedures. Recommended protection architectures are described in G.803. Restoration schemes may operate by re-establishing the path by using the path set-up control system.

Care must be taken to avoid conflict between the various protection and restoration systems which may co-exist within a managed network. For example, protection or restoration in a network layer may need to be delayed for a period if the server layers can provide rapid response protection or restoration. Similarly, end-to-end sub-network connection or trail protection or restoration should not be attempted until any constituent connection protection or restoration actions have been completed.

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