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ABSTRACT

Conventional synchronous digital communications networks are static networks which can be adapted to short-time load fluctuations only to a limited extent.

This situation is improved by a network controller (NSE) which serves to establish logical connections in the synchronous digital communications network. The network controller comprises access means for receiving a request for a logical connection from a customer, selecting means for selecting a path for the logical connection to be established, and means for initiating the establishment of the logical connection over the selected path.

(Fig. 1)



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ORIGINAL
COMPLETE SPECIFICATION
STANDARD PATENT

Invention Title:

“A NETWORK CONTROL ARRANGEMENT”

The following statement is a full description of
this invention, including the best method of
performing it known to us:

This invention relates to a network controller and a method for establishing a logical connection in a synchronous digital communications network

Existing synchronous digital communications networks, such as SDH (synchronous digital hierarchy) or SONET (synchronous optical network), are static
5 networks, i.e., logical connections (virtual connections) in the communications network are established by a management system more or less permanently.

A article by O. Gonzalez Soto et al, "Netzplanung und -management", Elektrisches Nachrichtenwesen, Alcatel, 4th Quarter 1993, pages 366-377, it
10 describes a certain flexibility for covering unexpected demand fluctuations in SDH networks is achieved by a certain level of overprovision. This overprovision can be utilised by on-line management processes for short periods, i.e., for periods of a few days up to several months.

According to that article, the establishment of logical connections in the SDH network takes place within the scope of network planning and is based on demand
15 forecasts some years ahead. For planning purposes, the SDH network is divided into subnetworks which are optimized separately. The optimization takes place in two administrative layers using a least-cost routing method.

When, after completion of network planning, the capacity limit of existing connections is reached, the on-line management process generates a provisioning
20 request on the low-order-path administrative layer. When the capacity of the low-order-path administrative layer is exhausted, a provisioning request is directed to the high-order-path layer path setup process, where it can be executed automatically or via operating staff. Such provisioning requests are limited to the subnetworks and to the individual network operators. In addition, this type of adaptation can only take
25 into account bottlenecks over a period of several days. Frequent shorter bottlenecks can only be obviated by permanently making available additional transmission capacity, which then remains unused over long periods of time.

It is therefore an object of the invention to provide a network controller and a method of establishing logical connections in a synchronous digital communications
30 network which permit a better utilization of existing transmission capacities.

This specification discloses a network controller (NSE) for establishing logical connections in a synchronous digital communications network, including

- access means for receiving a request for a logical connection,

- selecting means for selecting a path for the logical connection to be established, and
- means for initiating the establishment of the logical connection over the selected path.

5 This specification discloses a method of establishing logical connections in a synchronous digital communications network, including the steps of:

- receiving a request for a logical connection by an access means;
- selecting a path for the logical connection by a selecting means; and
- initiating the establishment of the logical connection over the selected

10 path.

The invention is particularly suited for the establishment of leased lines.

Besides improving the utilization of existing transmission capacities, the invention has the advantages that transmission networks can be more flexibly adapted to demand, and that communications networks become more user-friendly and are

15 better adapted to user needs.

In an embodiment of the network controller the access means are adapted to additionally receive desired connection parameters including information on one or more of priority, bandwidth, time at which the requested connection is to be provided, desired duration of the provision of the requested connection, and/or

20 desired protection features of the requested connection, wherein the selecting means select the path based on the desired selection parameters, and wherein the output means are provided for outputting an acknowledgement signal which contains actual connection parameters of the logical connection to be established over the selected path.

25 This embodiment of the invention enables a customer to specify desired connection parameters, such as priority, bandwidth, time at which the respective connection is to be provided, desired duration of the provision of the requested connection, and/or desired protection and quality features of the requested connection. This opens up new business opportunities to the operators of

30 synchronous digital communications networks or subnetworks by permitting the automatic establishment of leased lines with predetermined features at any given time and for limited periods.

An embodiment of the invention will now be explained with reference to the accompanying drawing, in which:

Fig. 1 is a schematic block diagram of the management structure of a synchronous digital communications network with a network controller embodying the invention; and

Fig. 2 is a flowchart of the method embodying the invention.

The basic idea of the invention is to provide a network controller capable of receiving individual connection requests, to select a path for such a connection request through the communications network, and to initiate the establishment of the connection over the selected path.

Fig. 1 shows the hierarchical structure of the management of a synchronous digital communications network in block-diagram form. A communications network consists of different network elements, such as cross-connect systems DXC and add/drop multiplexers ADM, which are interconnected by physical connections, such as optical fibers or coaxial cables, to form a network.

For each group of like network elements of a subnetwork, a respective network element management unit SH is provided. This management unit is responsible for controlling and monitoring network-element-specific functions, such as the switching of logical connections, and for network-element-specific messages and alarms. The network element management units of a subnetwork are connected to a regional management unit, the so-called regional manager RM. The latter controls the establishment of logical connections, network planning, and network optimization in the subnetwork. The regional managers in the subnetworks are connected to a superordinate management unit, the so-called country manager CM. This superordinate management unit CM manages the communications network of a country or of an operator, for example.

According to the invention, a network controller NSE is provided for establishing logical connections. The network controller NSE is connected to the country manager CM. It includes access means in the form of, e.g., an Internet interface INET via which a customer KD can send a connection request to the network controller. The connection request contains the instruction to establish a logical connection within the communications network, for example a leased line from Stuttgart to London. The network controller then selects a path suitable for the

logical connection by a selecting means, e.g., a processor with an associated program memory which contains a selection program processing a selection algorithm.

5 The path can be selected in a variety of ways. One possibility is to provide the network controller with a memory containing data about the structure of the communications network. From this data, the potential paths, i.e., the paths existing in the communications network, can be determined. Via the connection to the country manager CM, the latter can be interrogated for the current usage of each potential path, on the basis of which the best path is then selected. It is also possible
10 to determine a cost parameter for each potential path taking into account the current usage and, for example, the length of the path. The selection is then made such that the lowest-cost connection is chosen. Advantageously, the data about the structure of the communications network are stored in the memory in the form of a routing table.

15 Another possibility of selecting the path is to route the connection request in parametric form, for example in the form of the originating and destination points of the connection, to the country manager, which then determines potential paths and communicates these to the network controller. From these potential paths, the best path can then be selected, for example also on the basis of a cost parameter.

20 The network controller NSE has means for initiating the establishment of the logical connection over the selected path. These include an interface device connectable to the country manager, such as a Q-interface as specified for management purposes in SDH (ITU-T G.773, March 1993). Via this interface, instructions are sent to the country manager to establish the logical connection over
25 the selected path. Advantageously, the network controller NSE additionally includes interfaces to country managers of other operators or countries. This permits a transborder connection setup with the inclusion of different operators, as information on the structure and utilization of adjacent communications networks can be accessed via the additional interfaces.

30 According to an advantageous development of the invention, the access means are designed to receive, in addition to the connection request, authentication information from a customer which makes it possible to unambiguously establish and verify the customer's identity. To that end, means for checking the

authentication information are provided in the network controller. This ensures that only authorized customers can direct a connection request to the network controller. In addition, automatic charging of the fees incurred for the connection to a charge account of the customer is made possible. Authentication can be effected by the use of a chip card of the customer, for example, on which the authentication information and a key are stored.

Fig. 2 shows a flowchart of the method according to the invention. The following steps are carried out:

Step S1: A request for a logical connection is received from a customer, preferably over an Internet hotline.

Step S2: All potential paths in the communications network are determined which are suitable for the establishment of the logical connection and which have capacity available. One of the potential paths is selected for the establishment of the connection. This is preferably done by determining a cost parameter for each potential path depending on the length of the path, the number of intermediate network elements, and the usage of the individual path segments, and selecting the lowest-cost path.

Step S3: The establishment of the logical connection over the selected path is initiated. To this end, the path parameters with the instruction to establish the logical connection are routed to the country manager. The connection setup itself is then performed by the management units using so-called managed objects as described in an article by M. P. Bosse et al, "Management von SDH-Netzelementen: eine Anwendung der Informationsmodellierung", Elektrisches Nachrichtenwesen Alcatel, 4th Quarter 1994, pages 329 to 338.

Between step S1 and step S2, authentication of the customer can advantageously take place in a further step S1A. To accomplish this, the customer transmits encrypted authentication information to the network controller, which then checks the authentication information to establish and verify the identity and authorization of the customer. Authentication can also be effected by the use of a chip card of the customer, for example, on which the authentication information and a key are stored.

A particularly advantageous development of the invention makes it possible to specify connection parameters desired by a customer, such as priority, bandwidth,

time at which the requested connection is to be provided, desired duration of the provision of the requested connection, and/or desired protection and quality features of the requested connection. These connection parameters are taken into account by the network controller in selecting a suitable path. When a suitable path
 5 has been found, the network controller sends an acknowledgement signal back to the customer which contains the actual connection parameters of the connection to be established.

The network controller includes a memory in which connection requests from different customers are stored until the execution of the respective connection
 10 request. This is advantageous in that, in the path search, other connection requests that have not yet been attended to, such as requests for a connection for an overlapping time period, are also taken into account. Listed below are some of the connection parameters that could be specified by a customer:

- High priority:
- 15 * Immediate connection setup or connection set up within X seconds or minutes
- * Connection setup for a duration of X hours from the time of acknowledgement
- Average priority:
- 20 * Connection setup within one day, including main business hours (9 a.m. - 17 p.m.)
- * Connection setup during a predetermined period outside of main business hours. The period is made known 12 hours in advance.
- Low priority:
- 25 * Connection setup sometime outside of main business hours (at night).

The network controller includes output means, such as an Internet interface to the customer, via which an acknowledgement signal with the actual connection parameters is sent to the customer. This acknowledgement signal then indicates to the customer the actual time of the connection setup, for example. Advantageously,
 30 the cost parameter is computed on the basis of the actual connection parameters. This cost parameter, besides being used for the selection of a path, can also be employed for charging purposes. This makes it possible for the network controller to also provide the billing service. New business opportunities are opened up for the

- operators of synchronous digital communications networks or subnetworks as leased lines with predetermined bandwidth and protection features can be established automatically at any given time for limited periods. In addition, network flexibility is increased since the customer can now request connections limited in time, which was
- 5 not possible with conventional leased lines.



The claims defining the invention are as follows:

1. A network controller (NSE) for establishing logical connections in a synchronous digital communications network, including
 - access means for receiving a request for a logical connection,
 - 5 - selecting means for selecting a path for the logical connection to be established, and
 - means for initiating the establishment of the logical connection over the selected path.
2. A network controller as claimed in claim 1 wherein the access means are adapted to receive the connection request together with authentication information from a customer, and wherein checking means are provided for checking the authentication information.
- 10 3. A network controller as claimed in claim 2 wherein the access means are connectable with the customer via the Internet, and wherein the connection request is transmitted over the Internet.
- 15 4. A network controller as claimed in claim 1, including a memory for storing data about the structure of the communications network.
5. A network controller as claimed in claim 1, including an interface, connectable to management facilities of the communications network, for receiving data about the structure of the communications network and about the usage of connections existing in the communications network.
- 20 6. A network controller as claimed in claim 1, including computing means for computing a cost parameter for the selected path, and output means for outputting the computed cost parameter.
- 25 7. A network controller as claimed in claim 1 wherein the access means are adapted to additionally receive desired connection parameters including information on one or more of priority, bandwidth, time at which the requested connection is to be provided, desired duration of the provision of the requested connection, and/or desired protection features of the requested connection, wherein the selecting means select the path based on the desired selection parameters, and wherein the output means are provided for outputting an acknowledgement signal which contains actual connection parameters of the logical connection to be established over the selected path.
- 30

8. A network controller as claimed in claims 6 and 7 wherein the computing means compute the cost parameter based on the actual connection parameters.

9. A method of establishing logical connections in a synchronous digital communications network, including the steps of:

- 5 - receiving a request for a logical connection by an access means;
 - selecting a path for the logical connection by a selecting means; and
 - initiating the establishment of the logical connection over the selected path.

10. A method as claimed in claim 9 wherein the connection request is received from a customer, and wherein authentication of the customer is effected by the use of a chip card.

11. A network controller arrangement substantially as herein described with reference to the accompanying drawings.

12. A method of establishing logical connections substantially as herein described
15 with reference to the accompanying drawings.

DATED THIS TENTH DAY OF FEBRUARY 1999

~~ALCATEL~~

Freehills Carter Smith Beadle



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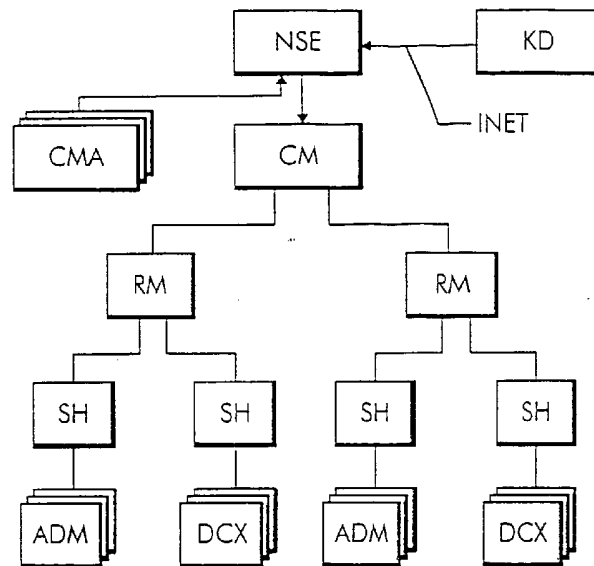


Fig. 1

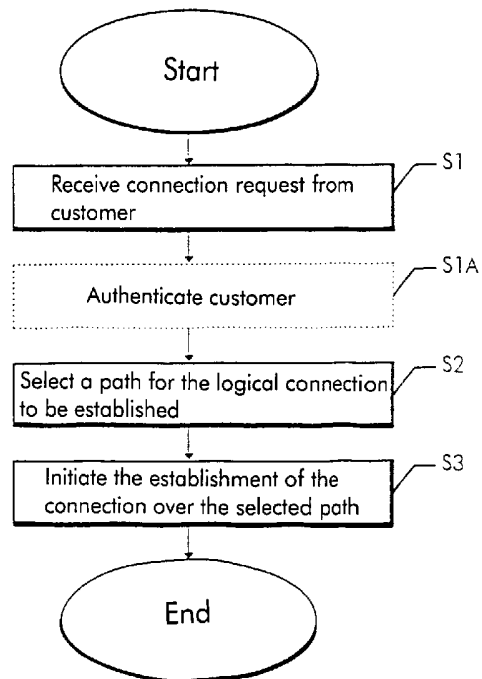


Fig. 2