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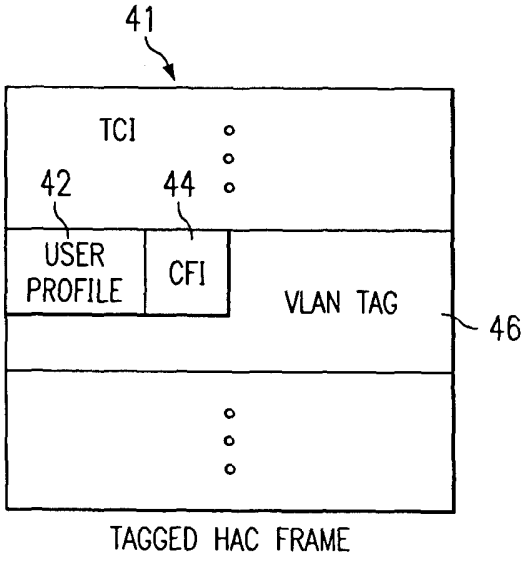
(54) Title: SYSTEM AND METHOD OF MULTIPLEXING DATA FROM MULTIPLE PORTS



(57) Abstract: Telecommunication equipment of the present invention includes a switch for receiving data from a plurality of ports and inserting a unique port identifier in the data from each port to identify the source port of the data. The equipment also includes a multiplexer coupled to the switch and operable to multiplex the data from the plurality of ports into a single serial data stream. A method of the present invention includes the steps of receiving data from a plurality of ports, adding a unique port identifier to the data from each port to identify the port from which the data came, and multiplexing the data from the plurality of ports into a single data stream for transmission.

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SYSTEM AND METHOD OF MULTIPLEXING DATA FROM MULTIPLE PORTS

TECHNICAL FIELD OF THE INVENTION

This invention relates to telecommunications network and equipment, and more particularly, to a system and method of multiplexing data from multiple ports.

BACKGROUND OF THE INVENTION

The optical subscriber terminal is a customer premise equipment (CPE) that aggregates and transports both Ethernet and time-division multiplexed (TDM) customer traffic to and from a network routing device and the network beyond. Customer Ethernet traffic may include data at 10 Mb/s, 100 Mb/s or higher rates from customers' Ethernet local area networks, while TDM data may consist of data at DS3 (or STS-1) and T1 speeds. The customer traffic is aggregated into an optical uplink for transmission to the network routing device.

Typically, data from the Ethernet ports are multiplexed at the physical layer into multiple respective SONET STS-1 synchronous payload envelopes (SPEs) as a serial data stream. The serial data stream is converted into a SONET optical signal for transmission to the network routing device. The network routing device demulitplexes the serial data stream to recover data from each individual Ethernet port for processing by higher layer network equipment such as routers. This conventional method is inefficient in bandwidth utilization, because the data from each port is mapped into its respective SPE. The conventional method also requires substantial processing in the higher layer network equipment such as routers.

SUMMARY OF THE INVENTION

It may be seen that there is a need for a more efficient system and method of multiplexing data from several Ethernet ports at customer premises equipment for transport to a telecommunication network.

In accordance with an embodiment of the present invention, telecommunication equipment includes a switch for receiving data from a plurality of ports and inserting a unique port identifier in the data from each port to identify the source port of the data. The equipment also includes a multiplexer coupled to the switch and operable to multiplex the data from the plurality of ports into a single serial data stream.

In accordance with another embodiment of the present invention, a method includes the steps of receiving data from a plurality of ports, adding a unique port identifier to the data from each port to identify the port from which the data came, and

multiplexing the data from the plurality of ports into a single data stream for transmission.

In accordance with yet another embodiment of the present invention, a method of multiplexing data from a plurality of ports for transmission includes the steps of receiving data from the plurality of ports, adding a unique port identifier to a predetermined header field of the data from each port to identify the port from which the data came, multiplexing the data from the plurality of ports into a single SONET synchronous payload envelope, and converting the multiplexed data into a SONET optical signal for transmission.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention, the objects and advantages thereof, reference is now made to the following descriptions taken in connection with the accompanying drawings in which:

FIGURE 1 is simplified block diagram of an embodiment of customer premise equipment operable to multiplex data from multiple ports into a single synchronous payload envelope according to the teachings of the present invention;

FIGURE 2 is a more detailed block diagram of an embodiment of customer premise equipment operable to multiplex data from multiple Ethernet ports into a single synchronous payload envelope according to the teachings of the present invention; and

FIGURE 3 is a diagram showing an embodiment of a tagged media access control (MAC) frame with the VLAN tag field used according to the teachings of the present invention.

DETAILED DESCRIPTION OF THE DRAWINGS

The preferred embodiment of the present invention and its advantages are best understood by referring to FIGURES 1 through 3 of the drawings, like numerals being used for like and corresponding parts of the various drawings.

FIGURE 1 is simplified block diagram of an embodiment of customer premise equipment 10 operable to multiplex data from multiple ports into a single synchronous payload envelope (SPE) according to the teachings of the present invention. Equipment 10 receives data from a plurality of ports 14 carrying data, such as Ethernet ports. Ethernet ports 14 may carry data at 10 Mb/s, 100 Mb/s, or higher rates. Equipment 10 includes a multiplexer device 12, which receives the data from the multiple Ethernet ports 14 and inserts a unique port identifier or tag identifying the source port the data originated. The tag is inserted into a predetermined data field in the header of the data. For example, a source port identifier tag may be inserted into a predetermined field in the Ethernet frame tag header. Multiplexer device 12 multiplexes the data from the multiple Ethernet ports into a single SPE transmitted as a serial data stream 16 to a telecommunication network (not shown). For example, serial data stream 16 may have SONET formatting in which data traffic from all the ports are multiplexed into a single SONET SPE

instead of the data from each port being mapped into its own respective SPE. Bandwidth efficiencies are thus achieved.

FIGURE 2 is a more detailed block diagram of an embodiment of customer premise equipment 22 operable to multiplex data from multiple Ethernet ports 14 into a single synchronous payload envelope according to the teachings of the present invention. Equipment 22 includes an Ethernet interface circuit 26 which receives data from multiple Ethernet ports. Ethernet interface circuit 26 includes transceivers, transformers and protection circuits as known in the art. A switch 28 receives the data from the plurality of ports and performs the primary functions of performing media access control, tagging all Ethernet frames with unique tags, and passing the tagged frames to a multiplexer/demultiplexer 30. Multiplexer/demultiplexer 30 then multiplexes the traffic into a single SONET STS21C SPE 16 for conversion to optical signals and transmission to a network routing device.

Referring to FIGURE 3, a diagram showing an embodiment of a tagged media access control (MAC) frame 40 with a virtual local area network (VLAN) tag field 46 to be used according to the teachings of the present invention is shown. The tagged MAC frame format is described in detail in ANSI/IEEE Standard 802.3, 2000 Edition, *Local and Metropolitan Area Networks--Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications*. Tagged MAC frame 40 includes a number of fields, including a tag control information (TCI) field 41. Tag control information field 41 includes a 3-bit user priority field 42, a 1-bit canonical format indicator (CFI) field 44, and a 12-bit VLAN identifier (VID) field 46. As described in the IEEE Standard 802.3, the VID field is used to identify the virtual LAN that the frame belongs to. A virtual LAN is a logical identification of a logical segment of a LAN representing a broadcast domain. Virtual LANs are identified to reduce the traffic on the LAN because broadcast and multicast messages may be sent to users on the virtual LAN rather than the entire LAN. The VID is therefore traditionally used to identify the VLAN to which the sender and receiver of the data belong.

The present invention provides a different use of the VID field by inserting a unique tag or identifier to identify the source Ethernet port of the data. An optical subscriber access multiplexer 24 receiving the optical uplink traffic from customer premises equipment 22 includes a multiplexer/demultiplexer 34 that demultiplexes the serial data stream to recover each individual Ethernet port data based on the source port identifier or tag in VID field 46, and provides the data to a routing device 36. Routing device 36 routes the traffic based on the source port identifier, MAC address and IP address to its output 38. Because the identification of an Ethernet port in effect identifies a service subscriber, it is also possible to transmit and process the data traffic according to the subscriber service level agreement (SLA) and quality of service (QoS).

In the reverse direction, routing device 36 receives data and adds the unique source port tag based on the source IP address of the sending device of the data. Multiplexer/demultiplexer 34 then multiplexes the data into an STS21C SPE for transmission to equipment 22. Multiplexer/demultiplexer 30 of

equipment 22 demultiplexes the SPE to produce an output to switch 28. Based on the source port tag, switch 28 switches the data to the proper destination Ethernet port 14.

While the invention has been particularly shown and described by the foregoing detailed description, it will be understood by those skilled in the art that various changes, alterations, modifications, mutations and derivations in form and detail may be made without departing from the spirit and scope of the invention.

WHAT IS CLAIMED IS:

1. A telecommunication equipment, comprising:

a switch receiving data from a plurality of ports and operable to insert a unique port identifier in the data from each port to identify the source port of the data; and

a multiplexer coupled to the switch and operable to multiplex the data from the plurality of ports into a single serial data stream.

2. The telecommunication equipment, as set forth in claim 1, wherein the switch receives data frames from a plurality of Ethernet ports.

3. The telecommunication equipment, as set forth in claim 1, wherein the multiplexer is operable to multiplex the data from the plurality of ports into a single SONET synchronous payload envelope.

4. The telecommunication equipment, as set forth in claim 1, wherein the multiplexer is operable to convert the single serial data stream into optical signals.

5. The telecommunication equipment, as set forth in claim 1, further comprising a subscriber access multiplexer operable to receive the single serial data stream from the multiplexer, demultiplex the serial data stream into data from each port, and route the data based on the unique port identifier.

6. The telecommunication equipment, as set forth in claim 1, wherein the switch is operable to insert the unique port identifier into a VID data field of a tagged MAC frame of the data from each port.

7. The telecommunication equipment, as set forth in claim 1, further comprising:

a subscriber access multiplexer operable to receive data from a plurality of sender nodes in a network and operable to insert the unique port identifier based on an IP address of the sender node of the data, and multiplex the data into a single serial data stream;

the multiplexer being operable to receive the single serial data stream from the subscriber access multiplexer and demultiplex the data; and

the switch being operable to switch the demultiplexed data based on the unique port identifier to the plurality of ports.

8. The telecommunication equipment, as set forth in claim 1, further comprising a subscriber access multiplexer operable to receive the single serial data stream from the multiplexer and route the data to a destination network node based on the unique port identifier, a MAC address and IP address in the data.

9. A method comprising:

receiving data from a plurality of ports;

adding a unique port identifier to the data from each port to identify the port from which the data came; and

multiplexing the data from the plurality of ports into a single data stream for transmission.

10. The method, as set forth in claim 9, wherein receiving data comprises receiving data from a plurality of Ethernet ports.

11. The method, as set forth in claim 9, wherein multiplexing the data comprises multiplexing the data into a single SONET synchronous payload envelope.

12. The method, as set forth in claim 9, wherein adding the unique port identifier comprises inserting the unique port identifier into a VID field of a tagged MAC frame of the data.

13. The method, as set forth in claim 9, further comprising converting the single serial data stream into SONET optical signals for transmission.

14. The method, as set forth in claim 9, further comprising:

receiving the single serial data stream;

demultiplexing the single serial data stream into data from each port; and

routing the data from each port based on the unique port identifier.

15. The method, as set forth in claim 9, further comprising:

receiving data from a plurality of sender nodes in a network;

inserting a unique port identifier based on an IP address of the sender node of the data; and

multiplexing the data into a single serial data stream for transmission;

receiving the transmitted data and demultiplexing the data into data from each sender node; and

switching the demultiplexed data based on the unique port identifier to the plurality of ports.

16. The method, as set forth in claim 9, further comprising receiving the single serial data stream and routing the data to a destination network node based on the unique port identifier, a MAC address and IP address in the data.

17. A method of multiplexing data from a plurality of ports for transmission, comprising:

receiving data from the plurality of ports;

adding a unique port identifier to a predetermined header field of the data from each port to identify the port from which the data came;

multiplexing the data from the plurality of ports into a single SONET synchronous payload envelope; and

converting the multiplexed data into a SONET optical signal for transmission.

18. The method, as set forth in claim 17, wherein receiving data comprises receiving data from a plurality of Ethernet ports.

19. The method, as set forth in claim 17, wherein adding the unique port identifier comprises inserting the unique port identifier into a VID field of a tagged MAC frame of the data.

20. The method, as set forth in claim 17, further comprising:

receiving the SONET optical signal and converting to a single data stream;

demultiplexing the data stream from each port; and

routing the data from each port based on the unique port identifier.

21. The method, as set forth in claim 17, further comprising:

receiving data from a plurality of sender nodes in a network;

inserting a unique port identifier based on an IP address of the sender node of the data;

multiplexing the data into a single serial data stream for transmission;

receiving the transmitted data and demultiplexing the data into data from each sender node; and

switching the demultiplexed data based on the unique port identifier to the plurality of ports.

22. The method, as set forth in claim 17, further comprising receiving the single serial data stream and routing the data to a destination network node based on the unique port identifier, a MAC address and IP address in the data.

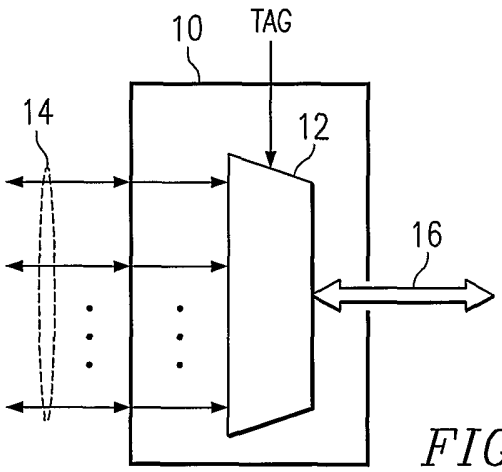

FIG. 1

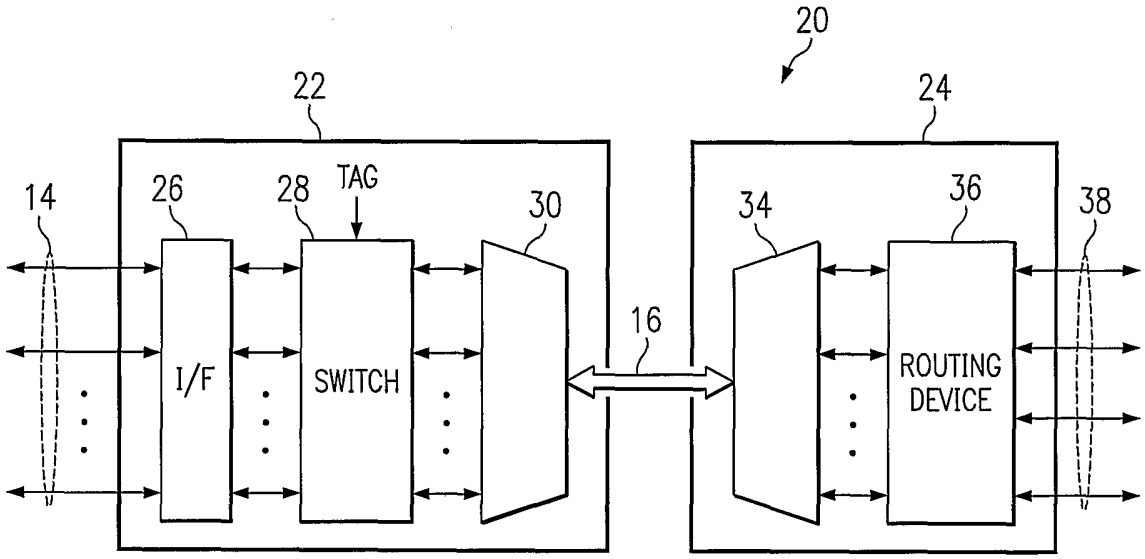

FIG. 2

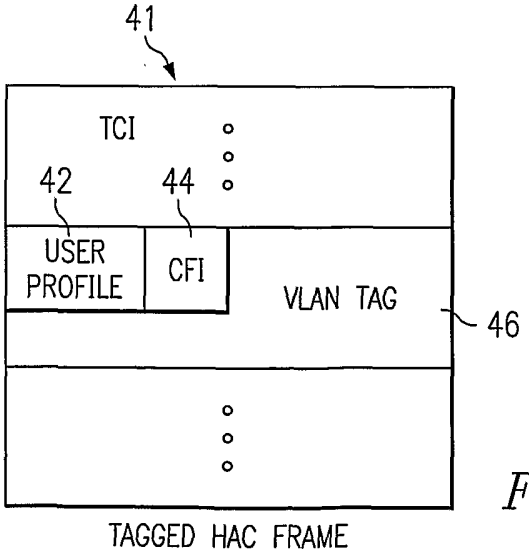

FIG. 3