

Description

This invention relates to an optical communications network in which optical signals in the form of pulses of light are transmitted over optical fibre transmission paths. Usually optical communications networks are used to transmit information at high speed between two nodes and are used to convey large volumes of information. The electro-optic devices which are used as transmitters in such systems usually have the form of semiconductor lasers and are part of sophisticated equipment including control circuitry to control the output of the laser as well as a heat sink and cooling arrangements to prevent the transmitter from overheating. The signal transmitted by such a transmitter may well be a time division multiplex signal so that a large number of different channels of information are transmitted simultaneously over the same optical fibre transmission path but, in this case, all of these channels of information are transmitted by the same optical transmitter.

US-A-4 027 153 describes an optical fibre network comprising a number of subscriber stations interconnected by a passive optical power divider. Control of the transmitters and receivers of the subscriber stations is accomplished by a central common addressing unit which polls the stations in turn. The stations respond by transmitting message packets through the network and the power divider to all the other stations.

The present invention provides an optical communications network in which the received signal at the central node is substantially constant no matter what splitting ratio is adopted in the passive splitter by virtue of the feature set out in claim 1.

Typically by a low duty cycle the optical transmitter is enabled to transmit information for only 10% or less of the total time and for a maximum time of 500 ns. This is very much less than conventional optical transmitters which are able to transmit information for 100% of the time but, for, typically 50% of that time are operating to transmit data represented by no pulse of light. Preferably the information is transmitted for a maximum time of 250 ns and typically for 60 ns when the power divider has a splitting ratio of 1:128. It is also possible to transmit for periods as short as 0.5 or 1 ns. With an arrangement in accordance with this invention it is preferred that the optical broadcast network operates an optical time division multiplex system between the node and the number of remote stations with each remote station being enabled to transmit in its own, individual time slot so that the optical signals from the remote stations interleave with one another at the node.

One way, and the preferred way, in which the present invention can be used is to operate the

optical transmitter at a high peak power many times greater than its maximum continuous power rating but, below its power damage rating under pulsed conditions. When, for example, the optical transmitter is operating a 10% duty cycle with a short period it is possible for the peak output power to be increased to ten times the maximum continuous power rating for the transmitter whilst still providing only the same thermal dissipation, assuming that the optical transmitter has a linear power to drive current relationship.

With such an arrangement it is possible to get a substantially constant received signal at the node no matter what splitting ratio is adopted in the optical power dividers by simply increasing the power of the optical transmitter in inverse proportion to the splitting ratio. Also with this arrangement failures can be readily identified. For example, the optical transmitter is permanently turned ON either it fails catastrophically or a fuse or other protective element in series with the device isolates it within a short period of time or its optical output reduces so that it is immediately apparent at the receiving node that a failure has occurred because the output of one transmitter is very low.

Another way in which the present invention can be used is for the high peak power at which the optical transmitter of the remote station operates to be the maximum continuous rating of the optical transmitter. With this arrangement only a fraction of the normal heat load on the optical transmitter is generated and this reduces the need for a heat sink, allows the optical device to operate at a lower internal temperature at which it is more efficient, and usually eliminates the need for external or internal cooling devices. It also improves the life of the optical transmitter.

Depending upon the application it is possible to arrange for both of these groups of advantages to be gained simultaneously and thus, with a very short duty cycle of, for example, only 1% it would be possible to have an optical transmitter operating at ten times its maximum continuous rating but, at the same time, only dissipate 10% of the heat that it would generate if run continuously at its maximum rating and have its life increased, typically by ten times.

Two particular examples of optical broadcast networks in accordance with this invention will now be described with reference to the accompanying drawings, in which:-

Figure 1 is a diagram of a first network; and,

Figure 2 is a diagram of part of a second network.

The first example represents a conventional time division multiplex transmission system with transmissions from a central controlling node 1 taking place over a first optical fibre transmission

line 2 to an optical power divider 3. The signal power is divided in the divider 3 between N optical fibre transmission lines 4 which lead to N remote stations 5. Information is transmitted continuously over the transmission paths 2 and 4 to all of the remote stations 5 but, as usual in conventional time division multiplex systems, each remote station is enabled to receive only the information transmitted during its own time slot. The remote stations 5 communicate with the controlling node 1 by transmitting over the same optical fibre transmission paths 2 and 4, or alternatively over different optical fibre transmission paths with each remote station 5 being enabled to transmit only during its own predetermined transmission time slot. Typically the maximum time for which each remote station transmitter operates is $1/N$ of the total time and it may be much less than this. Each remote station 5 transmits information by modulating a sequence of low duty cycle pulses.

The second example which is shown in Figure 2 allows each node to broadcast to every other node without the need for common control. Each node is allocated time slots in which it can transmit modulated low duty cycle pulses and these pulses form a time division multiplex in the optical signal power divider 3 which is received by other nodes on the network.

Claims

1. An optical communications network comprising:

a central node (2) having an optical transmitter and an optical receiver; N remote stations, where $N > 1$, (5) each remote station having an optical transmitter and an optical receiver; at least one optical fibre transmission medium (2, 4) coupled between the central node and the remote stations, said optical fibre transmission medium including a passive splitter arrangement (3) having a ratio of $1:N$, said network being characterised in that it carries, in use, time division multiplexed signals, the network being adapted for carrying return signals from the remote stations time division multiplexed passively onto said transmission medium, the optical transmitter of each remote station being arranged to transmit information by modulating a sequence of low duty cycle pulses, the peak power of each such transmitted pulse being greater than the maximum continuous power rating of the optical transmitter in inverse proportion to the splitting ratio whereby the received signal at the central node (2) is substantially constant no matter what splitting ratio is adopted in the passive splitter and whereby the transmitter of each

remote station operates for not more than $1/N$ of the total time.

2. A network as claimed in claim 1, wherein the optical transmitter of each remote station is arranged to operate for much less than $1/N$ of the total time.
3. A network as claimed in either claim 1 or claims 2, wherein the optical transmitter of each remote station is arranged such that each transmitted pulse has a duration of not more than 1 nanosecond.

Patentansprüche

1. Optisches Kommunikationsnetzwerk, das aufweist:

einen Zentralknoten (2) mit einem optischen Sender und einem optischen Empfänger; N entfernte Stationen (5), wobei $N > 1$ und wobei jede entfernte Station einen optischen Sender und einen optischen Empfänger aufweist; mindestens ein optisches Faserübertragungsmedium (2, 4), das zwischen dem Zentralknoten und den entfernten Stationen gekoppelt ist, wobei das optische Faserübertragungsmedium eine passive Aufspaltanordnung (3) mit einem Verhältnis von $1:N$ aufweist, wobei das Netzwerk,

dadurch gekennzeichnet

ist, daß es bei Verwendung Zeiteilungs-Multiplexsignale überträgt, wobei das Netzwerk zum Übertragen von Rückkehrsignalen von den entfernten Stationen angepaßt ist, die passiv auf das Übertragungsmedium in Zeiteilung gemultiplext sind, wobei der optische Sender jeder entfernten Station angeordnet ist, um Information durch Modulieren einer Sequenz aus Impulsen bei niedrigem Arbeitszyklus zu übertragen, wobei die Spitzenleistung eines jeden derart gesendeten Impulses größer als die maximale Dauernennleistung des optischen Senders ist, und zwar in umgekehrtem Verhältnis zum Aufspaltverhältnis, wodurch das empfangene Signal an dem Zentralknoten (2) im wesentlichen konstant ist, und zwar ungeachtet, welches Aufspaltverhältnis in dem passiven Aufspalter angenommen ist, und wodurch der Sender jeder entfernten Station nicht länger als $1/N$ der Gesamtzeit arbeitet.

2. Netzwerk nach Anspruch 1, wobei der optische Sender jeder entfernten Station angeordnet ist, um für viel weniger als $1/N$ der Gesamtzeit zu arbeiten.



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The second example which is shown in Figure 2 allows each node to broadcast to every other node without the need for common control. Each node is allocated time slots in which it can transmit modulated low duty cycle pulses and these pulses form a time division multiplex in the optical signal power divider 3 which is received by other nodes on the network.

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remote station operates for not more than $1/N$ of the total time.

2. A network as claimed in claim 1, wherein the optical transmitter of each remote station is arranged to operate for much less than $1/N$ of the total time.

3. A network as claimed in either claim 1 or claims 2, wherein the optical transmitter of each remote station is arranged such that each transmitted pulse has a duration of not more than 1 nanosecond.

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ist, daß es bei Verwendung Zeitteilungs-Multiplexsignale überträgt, wobei das Netzwerk zum Übertragen von Rückkehrsignalen von den entfernten Stationen angepaßt ist, die passiv auf das Übertragungsmedium in Zeitteilung gemultiplext sind, wobei der optische Sender jeder entfernten Station angeordnet ist, um Information durch Modulieren einer Sequenz aus Impulsen bei niedrigem Arbeitszyklus zu übertragen, wobei die Spitzenleistung eines jeden derart gesendeten Impulses größer als die maximale Dauernennleistung des optischen Senders ist, und zwar in umgekehrtem Verhältnis zum Aufspaltverhältnis, wodurch das empfangene Signal an dem Zentralknoten (2) im wesentlichen konstant ist, und zwar ungeachtet, welches Aufspaltverhältnis in dem passiven Aufspalter angenommen ist, und wodurch der Sender jeder entfernten Station nicht länger als $1/N$ der Gesamtzeit arbeitet.

2. Netzwerk nach Anspruch 1, wobei der optische Sender jeder entfernten Station angeordnet ist, um für viel weniger als $1/N$ der Gesamtzeit zu arbeiten.



3. Netzwerk nach einem der Ansprüche 1 oder 2, wobei der optische Sender jeder entfernten Station derart angeordnet ist, daß jeder gesendete Impuls eine Dauer von nicht mehr als einer Nanosekunde hat.

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Revendications

1. Un réseau de communications optiques comprenant:

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un noeud central (2) pourvu d'un transmetteur optique et d'un récepteur optique; N stations (5) situées à distance, où $N > 1$, chaque station située à distance étant pourvue d'un transmetteur optique et d'un récepteur optique; au moins un milieu de transmission (2, 4) à fibres optiques couplé entre le noeud central et les stations situées à distance, ledit milieu de transmission à fibres optiques incluant un agencement passif (3) à lame séparatrice à rapport de 1:N, ledit réseau étant caractérisé en ce qu'il porte, en utilisation, des signaux multiplexés par division de temps, le réseau étant apte à porter des signaux de retour venant des stations situées à distance, multiplexés passivement par division de temps sur ledit milieu de transmission, le transmetteur optique de chaque station située à distance étant agencé de façon à transmettre une information en modulant une séquence d'impulsions à faible cycle opératoire, la puissance de pic de chacune de ces impulsions transmises étant supérieure à la puissance nominale continue maximale du transmetteur optique selon une proportion inverse au rapport de division, grâce à quoi le signal reçu au noeud central (2) est sensiblement constant, quel que soit le rapport de division adapté dans la lame séparatrice passive, et grâce à quoi le transmetteur ne fonctionne pas pendant plus de $1/N$ du temps total, à chaque station située à distance.

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2. Un réseau selon la revendication 1 dans lequel le transmetteur optique de chaque station située à distance est agencé de manière à fonctionner pendant un temps bien inférieur à $1/N$ du temps total.

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3. Un réseau selon la revendication 1 ou la revendication 2, dans lequel le transmetteur optique de chaque station située à distance est agencé d'une manière telle que la durée de chaque impulsion transmise ne dépasse pas 1 nanoseconde.

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