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(51) INT CL^6
H04B 10/08 10/12

(52) UK CL (Edition P)
H4B BK12 BK8

(56) Documents Cited
EP 0389097 A2 **EP 0347903 A2** **EP 0237184 A1**
US 4815804 A

(58) Field of Search
UK CL (Edition O) **H4B BKX BK12 BK8**
INT CL^6 **H04B 10/08 10/12 , H04J 14/02**
ONLINE WPI

(54) Abstract Title
Burst mode wavelength controller

(57) In burst mode optical networks transmitters only transmit data during very short time intervals. This allows standard wavelength control systems insufficient time to measure transmitter wavelengths. The measurement system of the present invention samples burst mode data and stores one such sample within a recirculating optical loop memory 6. A scanning based wavelength measurement system 1 then determines the wavelength of the sample and passes this information onto a control unit 12 which sends a wavelength correction signal 15 to the relevant transmitter.

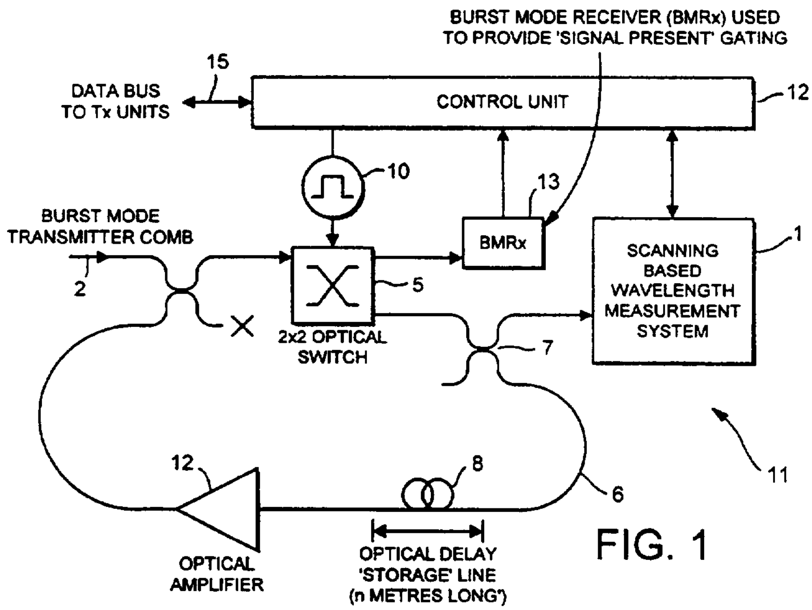

FIG. 1

GB 2 321 563 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

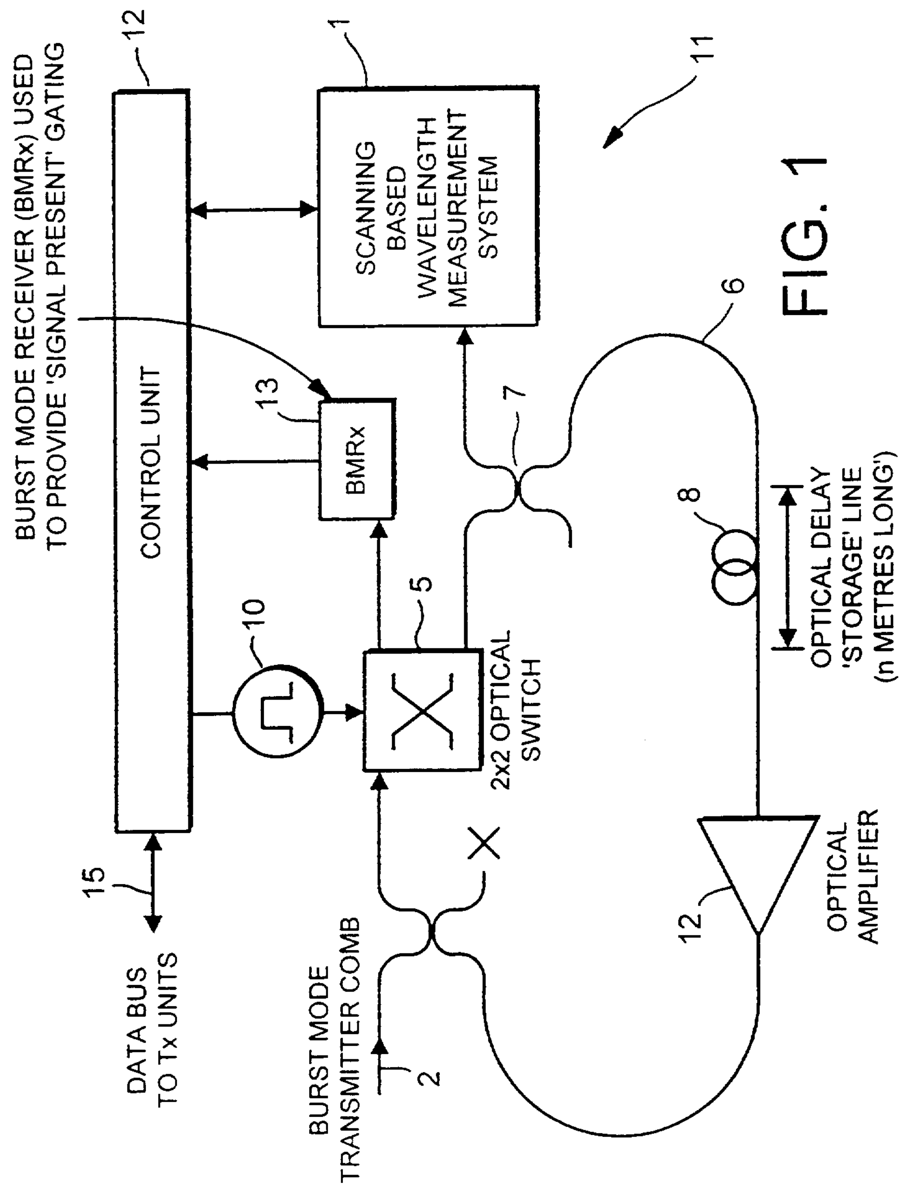
BURST MODE RECEIVER (BMRx) USED
TO PROVIDE 'SIGNAL PRESENT' GATING
12
CONTROL UNIT
1
SCANNING
BASED
WAVELENGTH
MEASUREMENT
SYSTEM
11
13
BMRx
10
5
7
6
8
15
DATA BUS
TO Tx UNITS
2x2 OPTICAL
SWITCH
OPTICAL DELAY
'STORAGE' LINE
(n METRES LONG')
BURST MODE
TRANSMITTER COMB
2
12
OPTICAL
AMPLIFIER

FIG. 1

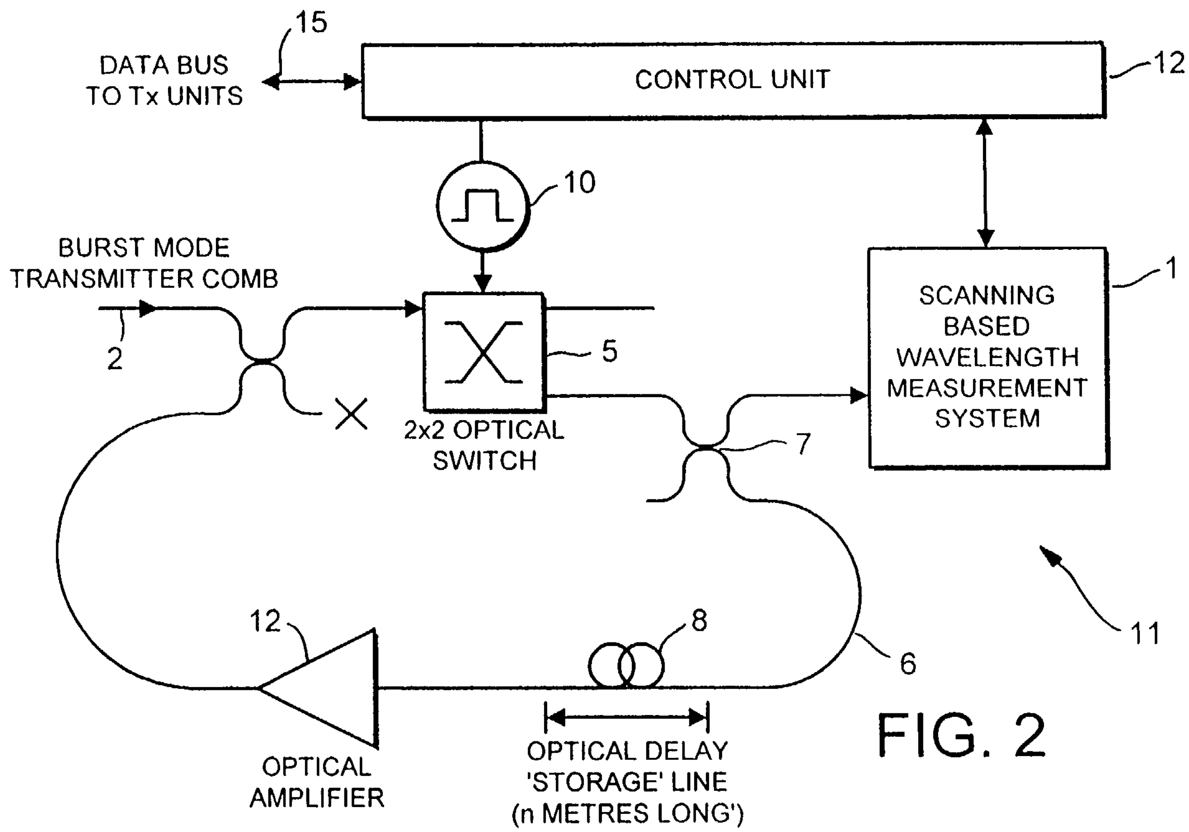
DATA BUS
TO Tx UNITS
15
CONTROL UNIT
12
10
BURST MODE
TRANSMITTER COMB
2
5
2x2 OPTICAL
SWITCH
7
1
SCANNING
BASED
WAVELENGTH
MEASUREMENT
SYSTEM
11
12
8
6
OPTICAL
AMPLIFIER
OPTICAL DELAY
'STORAGE' LINE
(n METRES LONG')

FIG. 2

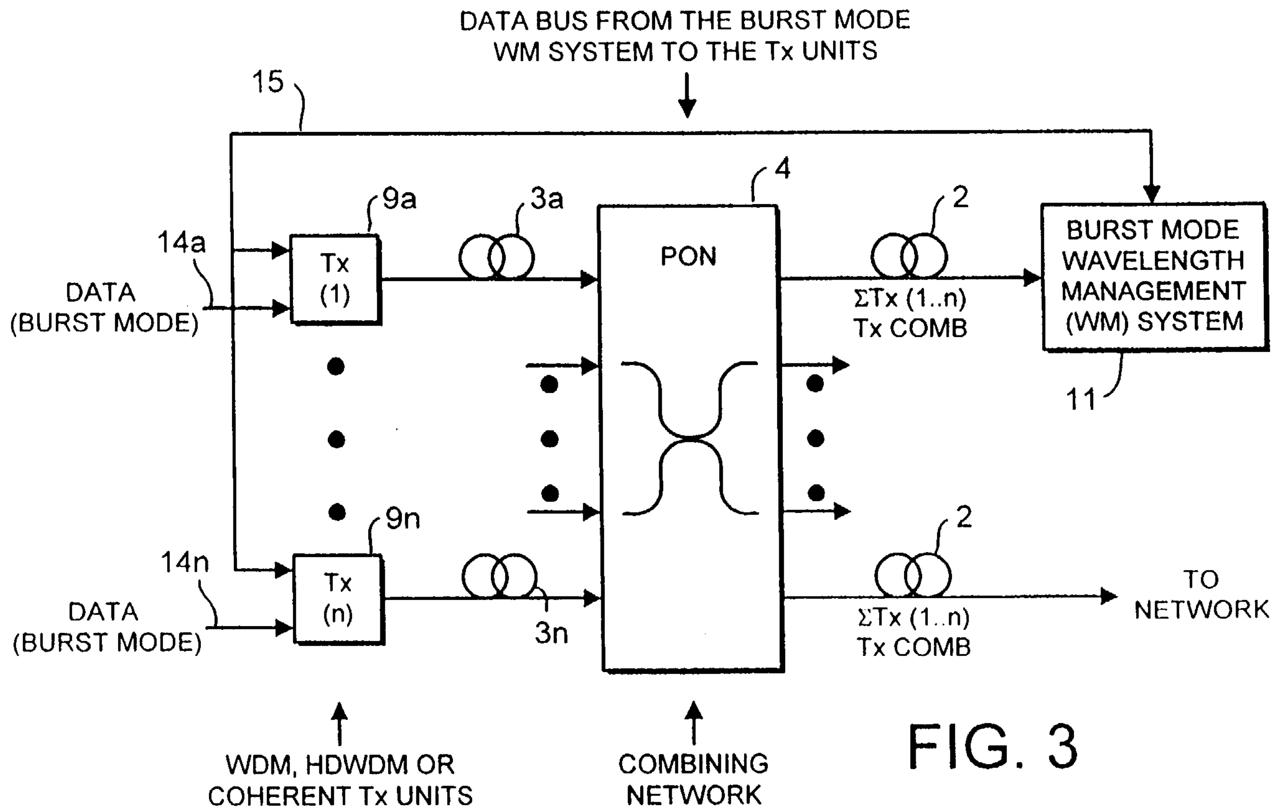
DATA BUS FROM THE BURST MODE
WM SYSTEM TO THE Tx UNITS
15
14a
DATA
(BURST MODE)
9a
Tx
(1)
3a
4
PON
2
ΣTx (1..n)
Tx COMB
BURST MODE
WAVELENGTH
MANAGEMENT
(WM) SYSTEM
11
14n
DATA
(BURST MODE)
9n
Tx
(n)
3n
2
ΣTx (1..n)
Tx COMB
TO
NETWORK
WDM, HDWDM OR
COHERENT Tx UNITS
COMBINING
NETWORK

FIG. 3

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BURST MODE WAVELENGTH MANAGER

The present invention relates to a means of controlling the wavelength of optical Wave Division Multiplex (WDM), High Density Wave Division Multiplex (HDWDM) or coherent-based transmitters in localised or distributed networks operating in burst mode (BM). Due to the Burst Mode Transmitters (BMTx) only transmitting data (and hence a detectable optical signal) for a very short time interval, standard wavelength control systems would have insufficient time to measure the BMTx wavelengths. The measurement system of the present invention "stores" the optical BM data stream transmitted by each BMTx and presents this to a scanning based wavelength measurement system to measure the BMTx wavelength and hence determine the required wavelength correction. This would be applicable in Multi-wavelength Passive Optical Networks (PONs) for management of upstream traffic BMTx units.

According to the present invention there is provided an optical network operating with burst mode data traffic signals comprising a recirculating 8 optical loop memory including means to take a sample of a burst mode data traffic signal and to store the sample within the recirculating optical loop memory.

The present invention will now be described by way of example, with reference to the accompanying drawings, in which:

Figure 1 shows a schematic drawing of a Burst Mode Wavelength Management System using "signal present gating";

Figure 2 shows a further schematic drawing of a Burst Mode Wavelength Management System using "self gating"; and

Figure 3 shows a schematic diagram of an Optical System using the Burst Mode Wavelength Management System of Figure 1 or Figure 2.

Considering the figures, a Burst Mode Wavelength Manager (BMWM) system 11 is illustrated using a Scanning Heterodyne or Scanning Filter based spectrometer (Scanning-based Wavelength Measuring System) 1, which monitors a BMTx comb 2. The comb 2 is produced by combining the BMTx signals 3.1-3.n from the transmitter units 9.1-9.n in a Passive Optical Network (PON) 4.

A 2x2 optical switch 5 is used to sample the incoming BMTx comb 2 allowing a short optical pulse to enter a recirculating optical loop memory 6.

A coupler 7 allows a portion of the comb travelling round the loop memory 6 to be tapped off and delivered to the Scanning-based Wavelength Measuring System 1. The optical switch 5 is then used to empty the loop memory 6 before the system is reset ready for another sample.

The length of the loop memory 6, typically single mode fibre based, is set by providing an optical delay storage line 8 of such a length that the gating period width only fills about 90% of the loop memory 6. For example, for a 100ns gating period width the storage line 8, which would form the major part of the loop memory would be approximately 30Km long. An optical amplifier 9 is included in the loop memory 6 to compensate for the round trip optical losses (couplers, fibre loss, splices, connectors, etc.). The optical amplifier 9 ideally should be wavelength flattened across the wavelength band of interest for both wavelength and power.

The frequency correction is calculated at a control unit 12 (required wavelength minus the measured wavelength from Scanning based Wavelength Measurement System 1), and the result is transmitted by a data bus 15 to the appropriate BMTx unit 9.1-9.n using a dedicated electrical connection (i.e. wire, twisted pair, RS232, RS422 or other point to point interface), electrical interface bus, (i.e. RS485, IEEE488, SCS1 or other multi-device bus-based interface) or via an optical overlay. The BMTx unit 9.1-9.n interprets this required correction, and alters the operating conditions of the unit's laser (i.e. increase/decrease laser bias currents or laser operating temperature).

Two different control schemes can be used. In the self-gating mode in Figure 2 the output from the Scanning based Wavelength Measurement System 1 passes to the control unit 12 which provides a periodic gating pulse 10 to the optical switch 5. In this mode the BMWM 11 can only sample at set time intervals and consequently has to sample at a sufficient rate to ensure that all channels are detected.

In the signal present gating mode in Figure 1, a Burst Mode Receiver (BMRx) 13 is attached to the second output of the optical switch 5. The BMRx 13 allows the TDMA signal to be detected and hence allows identification of the TDMA signal's source. Thus, knowing the origin of the source it is possible to concentrate the sampling on an individual transmitter or group of transmitters. This allows much faster diagnostic times and enables servicing of every TDMA transmitter.

CLAIMS

1. An optical network operating with burst mode data traffic signals comprising a recirculating optical loop memory including means to take a sample of a burst mode data traffic signal and to store the sample within the recirculating optical loop memory.

2. An optical network as claimed in Claim 1, further comprising a scanning based wavelength measurement system wherein the wavelength of the sample is determined.

3. An optical network as claimed in Claim 2, further comprising a plurality of transmitter units and an optical combing means to generate an optical comb.

4. An optical network as claimed in any preceding claim further comprising means to generate a sample control signal including a local clock.

5. An optical network as claimed in any one of Claims 1 to 3 comprising means to generate a sample control signal including a local signal present burst mode receiver.

6. An optical network as claimed in any claim appendent to Claim 2, further comprising means to calculate a frequency correction using the determined sample wavelength.

7. An optical network substantially as hereinbefore described with reference to and as illustrated in Figures 1 and 3 or 2 and 3 of the accompanying drawings.

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Application No: GB 9701488.0
Claims searched: 1-7
Examiner: Stephen Brown
Date of search: 24 March 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): H4B (BK8, BK12, BKX)

Int Cl (Ed.6): H04B: 10/08, 10/12, H04J: 14/02

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	EP 0 389 097 A2	(AT&T) See the abstract, figures 3 & 5, column 2, lines 32-49, column 5, lines 35-36, and column 6, lines 37-42.	1, 5
A	EP 0 347 903 A2	(NEC)	-
A	EP 0 237 184 A1	(Desurvire)	-
A	US 4 815 804	(Desurvire)	-

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.