Question 1 (3 p.)

Which of these does not significantly reduce the cross-talk due to four wave mixing in optical transmission fibres?

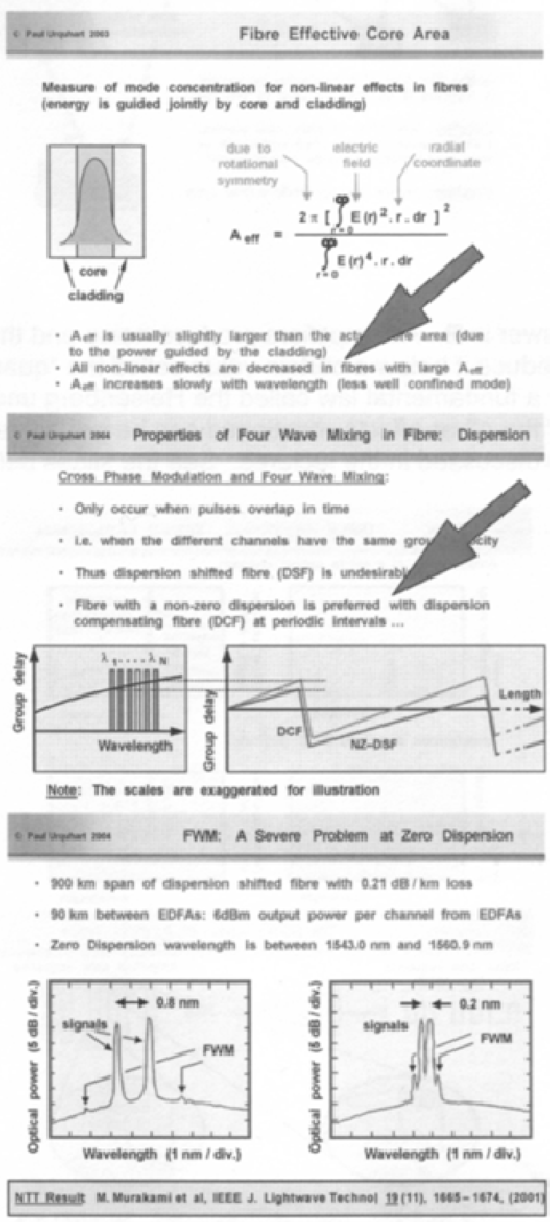
A- Use fibre with a larger effective core area

B- Use fibre with a larger dispersion coefficient

C- Use WDM with wider wavelength separation between the channels

D- Use fibre with a lower polarisation mode dispersion (PMD)

The required answer is D. Fibres with large dispersion & effective area and operation with channel separation minimize the non-linear cross-talk. However, PMD has little direct influence. See the slides below:



Question 2 (3 p.)

A "super-PON" is a passive optical network with amplifiers to serve a large number of customers. Which of these explanations is the one that is most commonly given to justify the use of super-PONs?

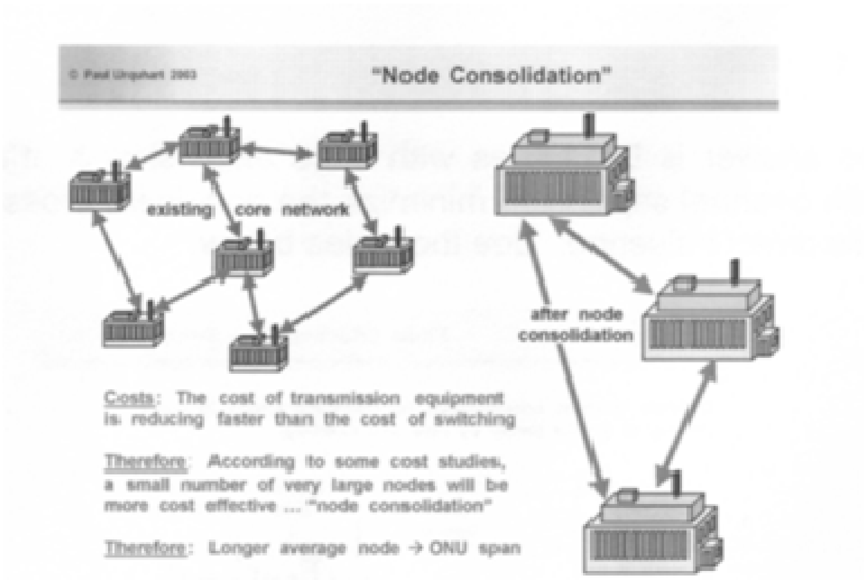
A- An increasing number of people are working from home. (They are known as "teleworkers".) They require higher bandwidth services.

B- Super-PONs allow the operator to serve a greater mixture of customers. Some are domestic customers and others are small businesses. It is therefore possible to reduce the costs.

C- SuperPONs allow the operator to reduce the number of nodes in the network. Node buildings and the equipment that they contain are particularly expensive.

D- Fibres are shared more effectively in superPONs, compared with metropolitan area networks that are configured as rings. The shorter fibre lengths provide cost savings because digging trenches in the ground is very expensive

The required answer is C. See the slide below:



Question 3 (3 p.)

Optical amplifiers, such as the erbium doped fibre amplifier (EDFA), are essential for optical communications but they also cause problems. Four problems are stated below. One of them is fundamental and cannot be overcome by any means. Which one is it?

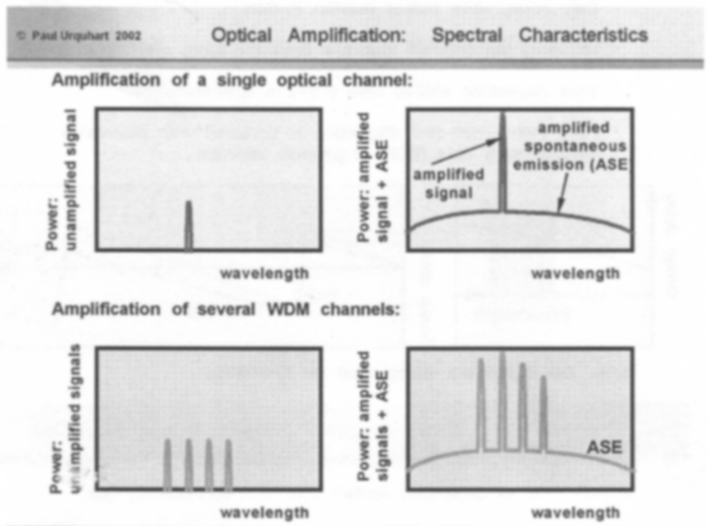
A- The gain varies with wavelength, which can cause great differences in channel powers after passing through a chain of amplifiers

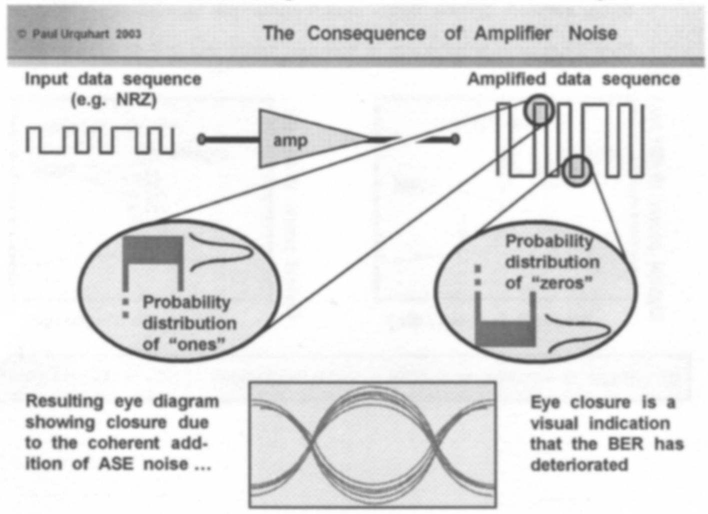
B- All amplifiers produce noise due to amplified spontaneous emission and this is transmitted to the detector together with the received signal

C- An amplified network that includes optical add-drop multiplexers can experience rapid power surges after the channels have been dropped or inserted.

D- The output power from an optical amplifier is sufficiently high to cause non-linear cross-talk in the transmission fibre

The required answer is B. All amplifiers produce noise and there is nothing that can be done to reduce it below a certain value called the "quantum limit", which is determined by a fundamental law called the Heisenberg uncertainty principle. In contrast, all of the other effects mentioned can be greatly reduced by various means that were discussed in the lectures. See the slides below:





Question 4 (3 p.)

Which kind of optical fibre is most commonly used in the trunk networks in Japan?

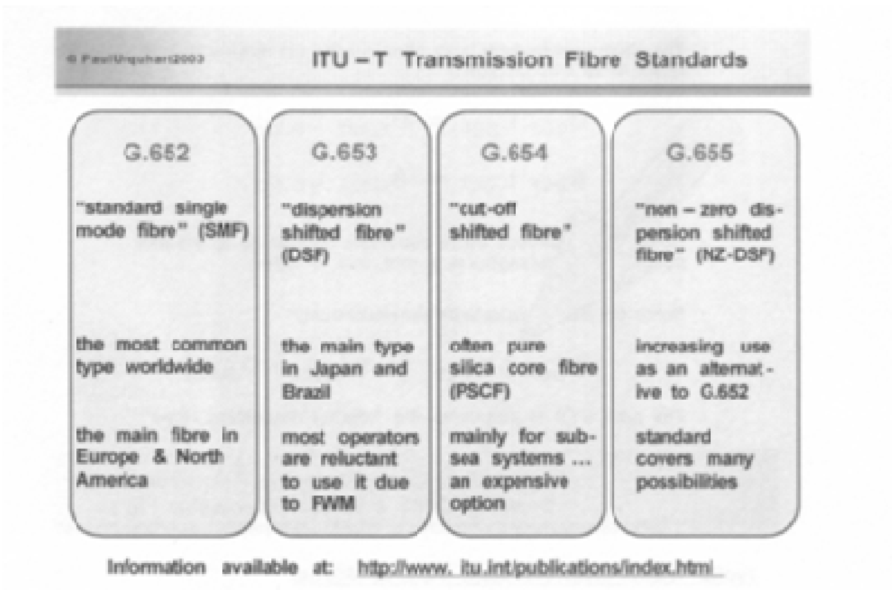
A- G.652, "Standard single mode fibre"

B- G.653, "Dispersion shifted fibre"

C- G.654, "Cut-off wavelength shifted fibre"

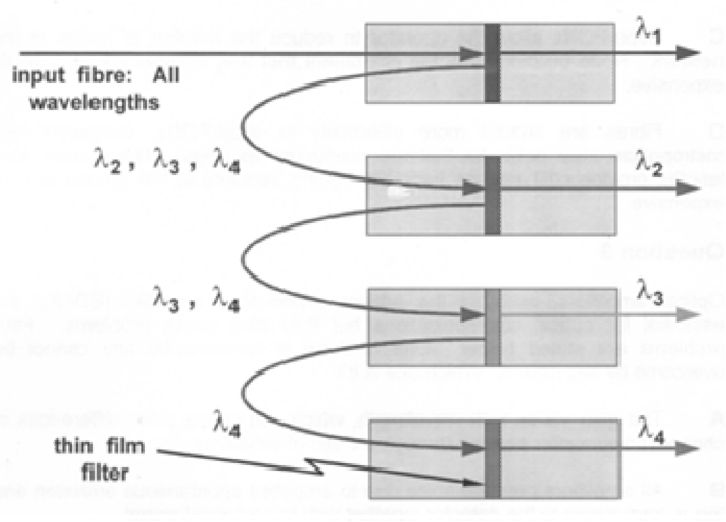
D- G.655, "Non-zero dispersion shifted fibre"

The required answer is B. The Japanese trunk network is mainly dispersion shifted fibre (DSF). Don't confuse it with dispersion compensating fibre (DCF), which is completely different. The slide below summarises the main types of transmission fibre:



Question 5 (3 p.)

A wavelength demultiplexer is made using thin film optical filters as shown below:



What is its main disadvantage?

A- It operates in reflection only and so optical circulators must also be used. (They are not shown in the diagram.) Circulators have additional losses and are expensive.

B- The thin film filters have side lobes in their transmission spectra. It is necessary to use apodisation to avoid the transmission of adjacent channels and this increases their cost.

C- Channel 1 passes through only one filter, channel 2 passes through two filters, channel 3 passes through three filters and so on. Therefore different channels experience different losses.

D- The loss in all of the channels is very high. This is because the light must be coupled from an optical fibre into the thin film filter and back into another optical fibre.

The required answer is C. The losses increase as channels pass through more filters. Option A is complete nonsense. Each TFF transmits its chosen channel. Option B is an exaggeration: if there are side lobes, they are not particularly significant. Option D is true but the losses are not very high. Typically the fibre-to-fibre losses would be about $1 - 2$ dB.

Question 6 (3 p.)

Which kind of optical fibre has been standardised by the International Telecommunications Union (ITU) for use in optical access networks?

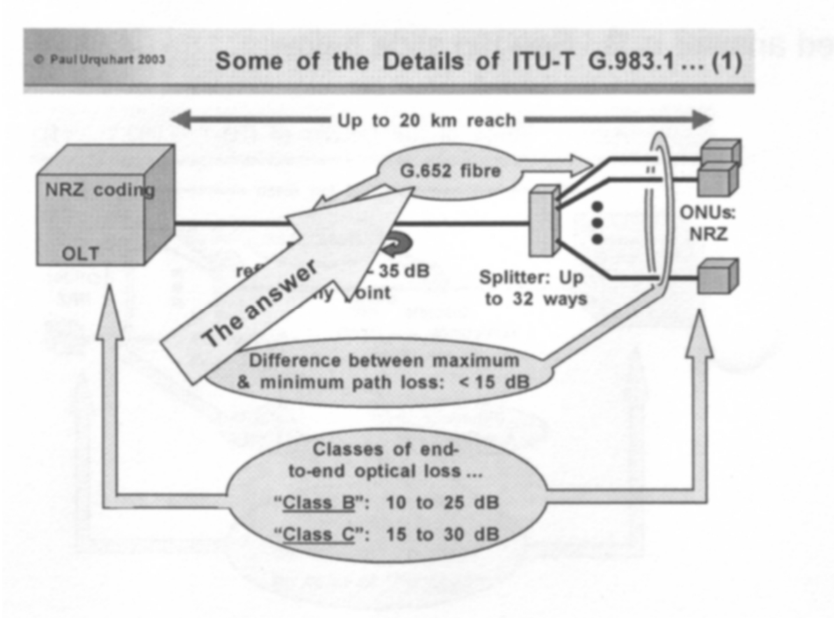
A- G.652, "Standard single mode fibre"

B- G.653, "Dispersion shifted fibre"

C- G.654, "Cut-off wavelength shifted fibre"

D- G.655, "Non-zero dispersion shifted fibre"

The required answer is A. See the slide below:



Question 7 (3 p.)

The relative dispersion slope of a dispersion compensating fibre (DCF) is defined as

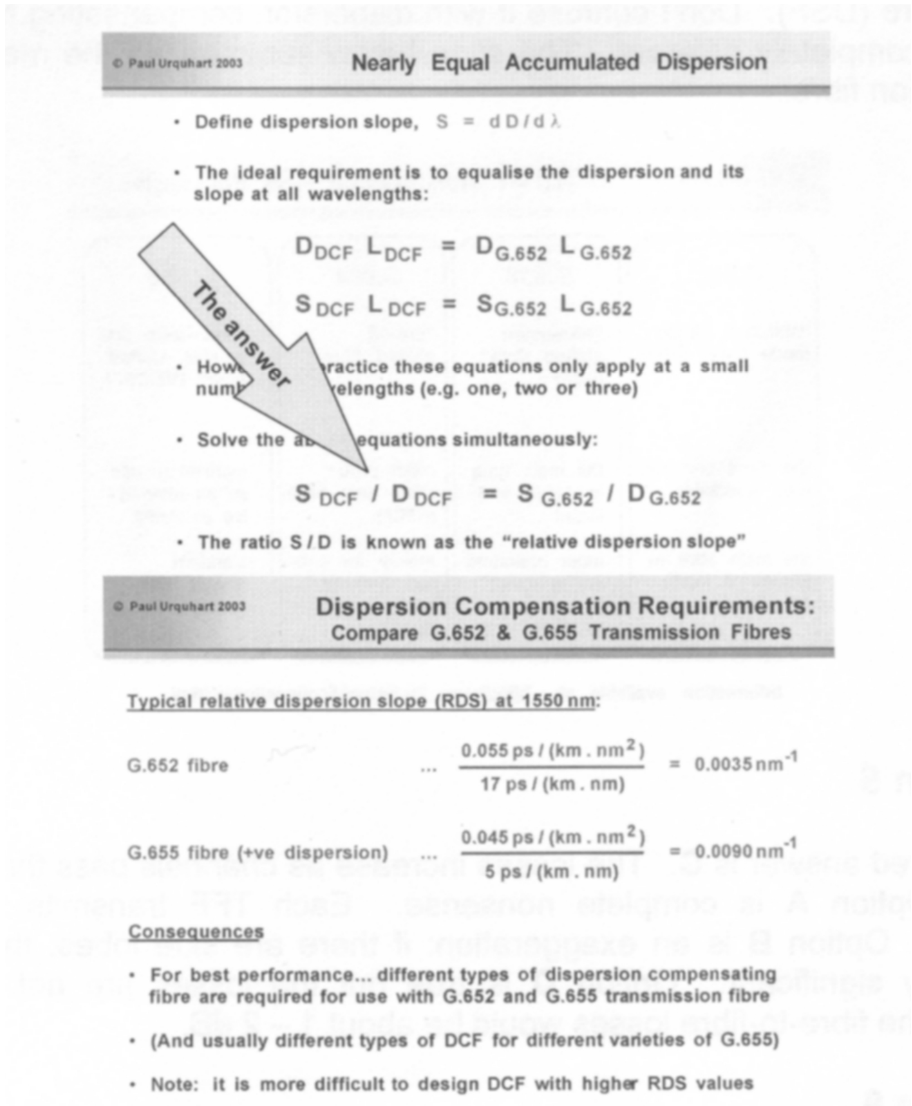
A- Dispersion coefficient of the DCF / Fibre loss coefficient of the DCF

B- Dispersion coefficient of the transmission fibre / Dispersion coefficient of the DCF

C- Dispersion slope coefficient of the DCF / Dispersion coefficient of the transmission fibre

D- Dispersion slope coefficient of the DCF / Dispersion coefficient of the DCF

The required answer is D. See the slides below:



Question 8 (3 p.)

According to the International Telecommunications Union (ITU) standard known as G.983.1, what is the maximum number of customers that can be served by an un-amplified passive optical network (PON) that is based on time division multiplexing?

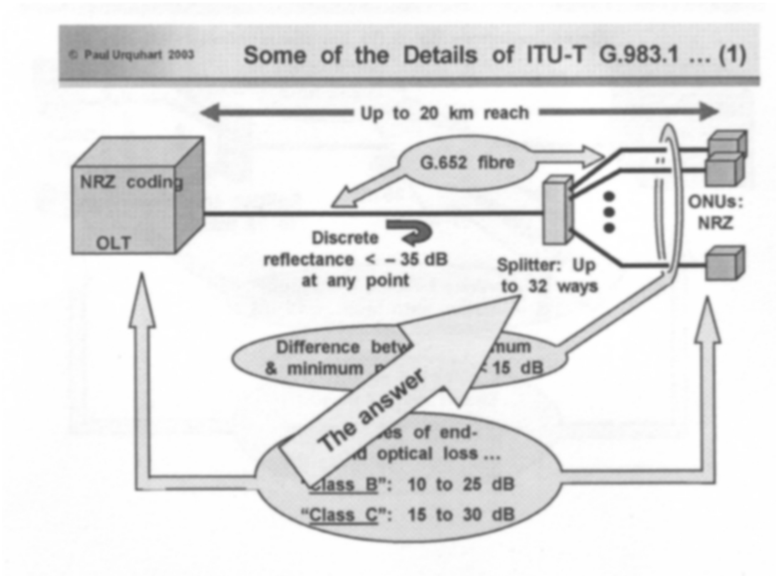
A- 16

B- 32

C- 64

D- 128

The required answer is B. See the slide below:



Question 9 (3 p.)

One of these statements about polarisation mode dispersion (PMD) in optical fibres is wrong. Which one is it?

A- PMD is a statistical phenomenon because it is caused by a very large number of effects that cannot be accurately predicted

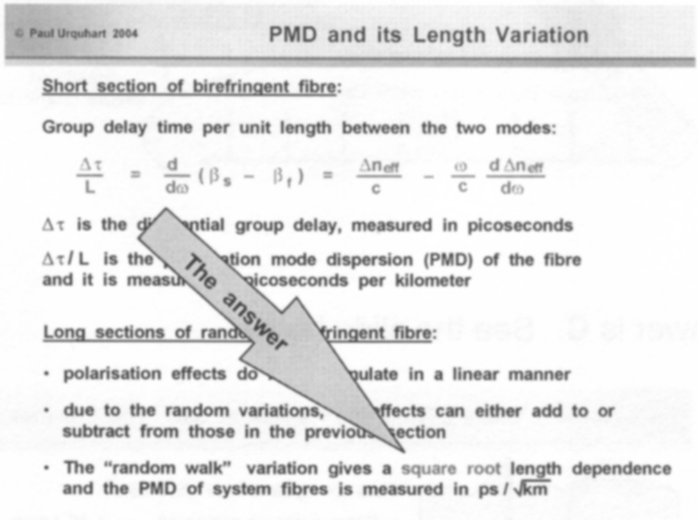
B- The differential group delay of a propagating pulse varies linearly with fibre length

C- PMD becomes more problematical for optical transmission as the data rate is increased

C- PMD is a greater problem in older optical fibres

The required answer is B. Statement B is incorrect because the variation is not linear. It is as the square root. Please take careful note of the wording of this question and others that are like it. Three of the statements are correct and the other is incorrect. You were asked to identify the one that was incorrect.

See the slide below:



Question 10 (3 p.)

The spectral region between 1530 nm and 1565 nm is known as the C-band. Why is it important?

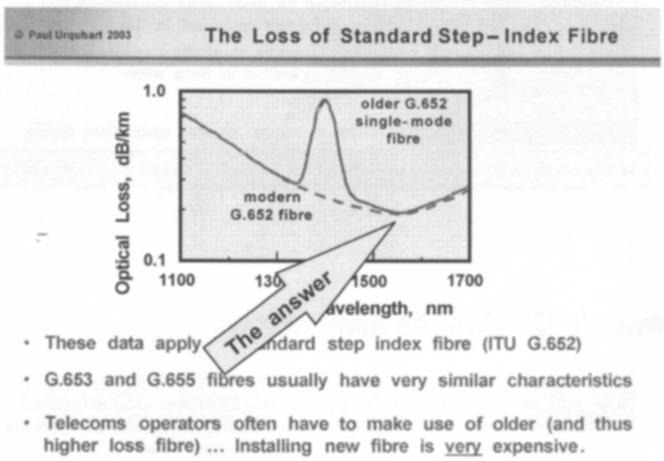
A- It is where the transmission fibre has the lowest loss

B- It is where the cost of lasers and modulators is lowest

C- It is where the dispersion of the transmission fibre is zero

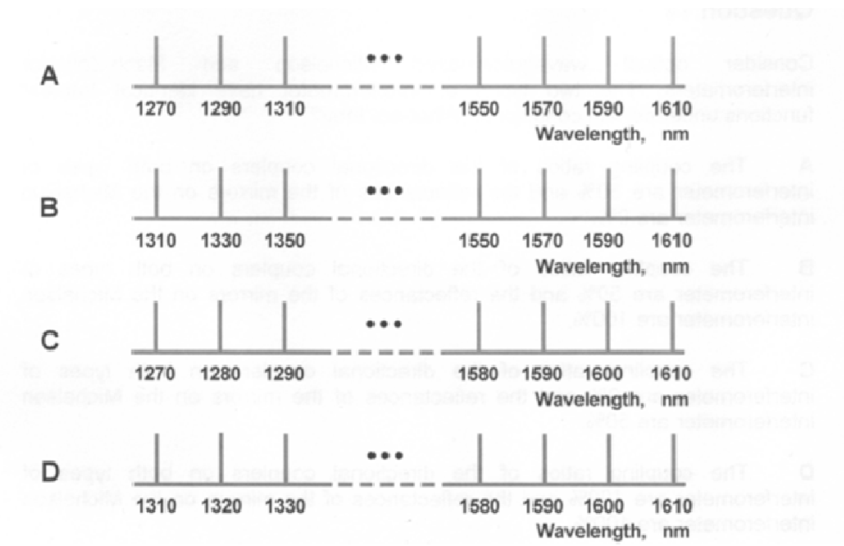
D- It is where erbium doped fibre amplifiers produce least noise

The required answer is A. See the slide below:

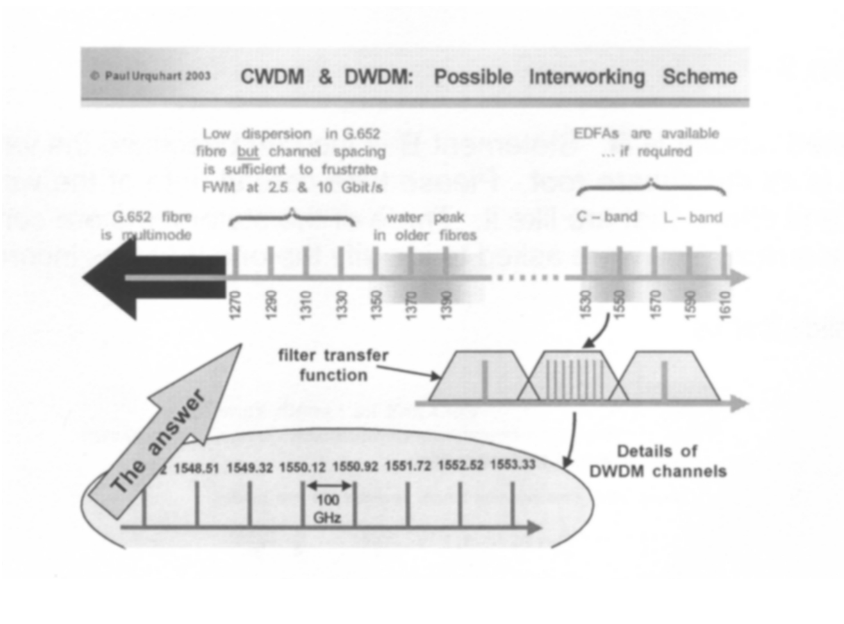


Question 11 (3 p.)

Four wavelength assignments for the International Telecommunications Union (ITU) standard on coarse wavelength division multiplexing (CWDM) are drawn on the next page. Only one is correct. Which is it?



The required answer is A. See the slide below:



Question 12 (3 p.)

Which of these operations imposes the greatest physical strain on a sub-sea cable in bad weather conditions?

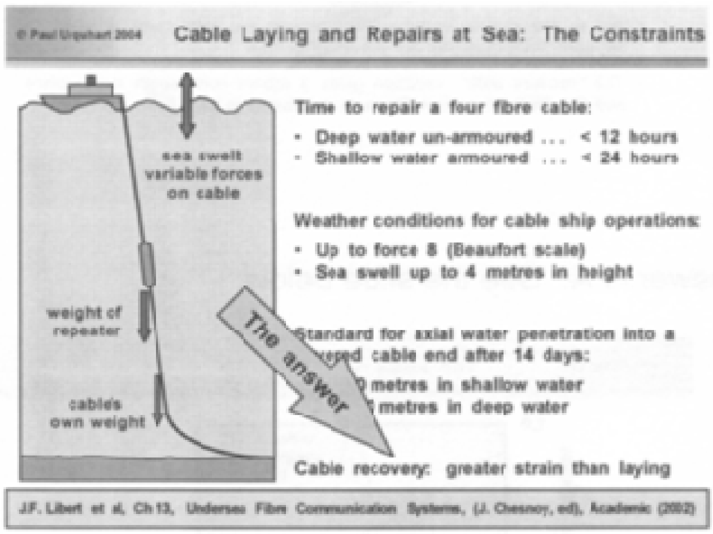
A- When the cable is attached to a cable ship while performing a repair

B- Cable laying in the middle of an ocean, where the water is deep

C- Cable recovery in the middle of the ocean in order to perform a repair

D- Cable laying off the continental shelf, where there are many other ships

The required answer is C. See the slide below:



Question 13 (3 p.)

Electrical power is supplied to a trans-oceanic system that has four fibre pairs, each with 32 WDM channels. A certain percentage of the power is consumed by the active components in the repeaters and the remainder is wasted for by the Ohmic losses of the electrical conductors. Typically, what percentage of the total power is accounted for by these two means?

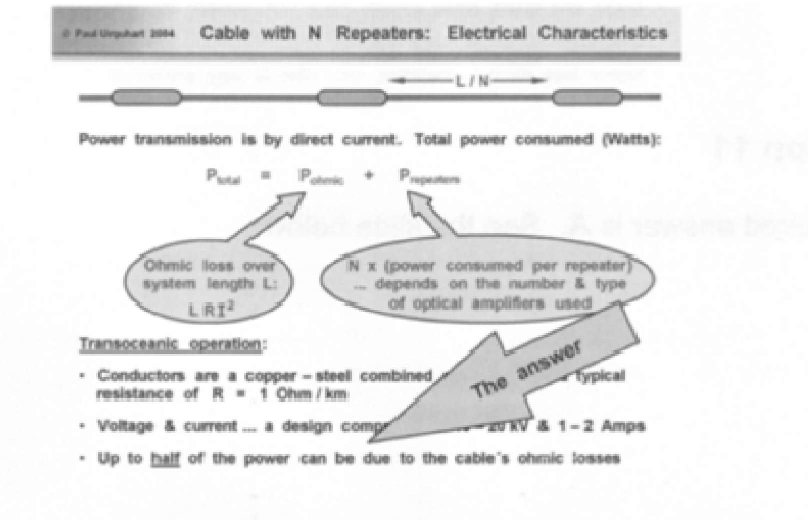
A- 1% Ohmic loss 99% repeaters

B- 10% Ohmic loss 90% repeaters

C- 50% Ohmic loss 50% repeaters

D- 90% Ohmic loss 10% repeaters

The required answer is C. See the slide below:



Note that even though the slide says "up to half the power", of the choices given. 50% is the closest. Moreover, the question refers to a 32 channel system. This is a large number and one would expect the pumps in the EDFAs (or other amplifiers) to draw a relatively large current in order to provide gain for so many channels.

Question 14 (3 p.)

Consider optical waveguide-based Michelson and Mach-Zehnder interferometers. The two types of interferometer have identical transfer functions under certain conditions. What are they?

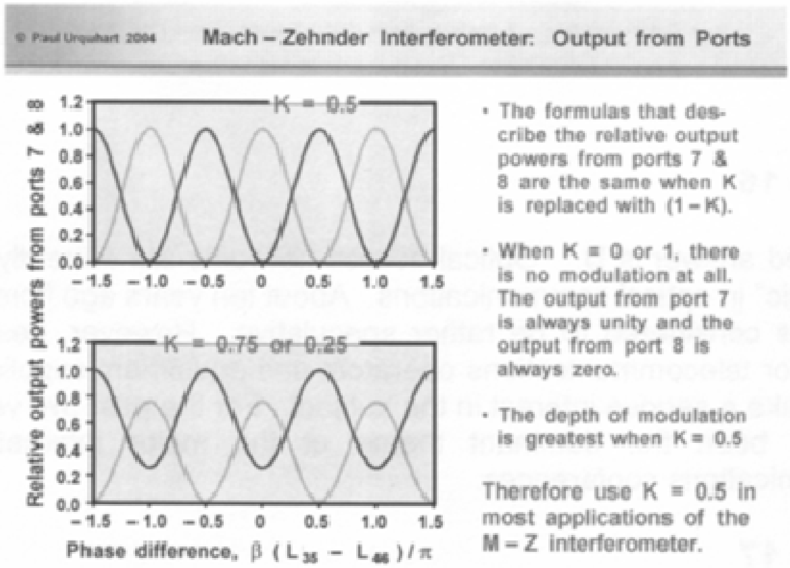
A- The coupling ratios of the directional couplers on both types of interferometer are 50% and the reflectances of the mirrors on the Michelson interferometer are 0%.

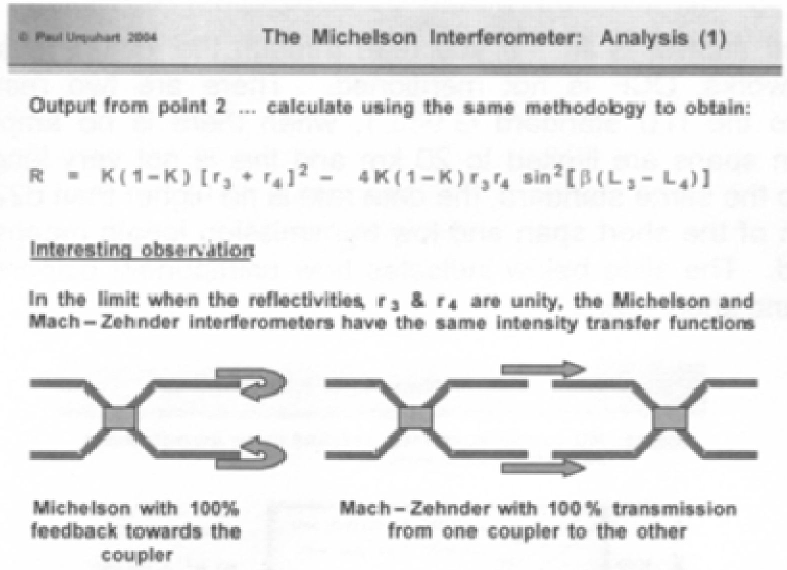
B- The coupling ratios of the directional couplers on both types of interferometer are 50% and the reflectances of the mirrors on the Michelson interferometer are 100%.

C- The coupling ratios of the directional couplers on both types of interferometer are 0% and the reflectances of the mirrors on the Michelson interferometer are 50%.

D- The coupling ratios of the directional couplers on both types of interferometer are 100% and the reflectances of the mirrors on the Michelson interferometer are 100%.

The required answer is B. See the slides below:





Question 15 (3 p.)

A cable in the middle of the Atlantic ocean is damaged at 08:00 hours on the 1st November. Four times and dates are stated below. The times are all with respect to a 24 hour clock and they refer to the local time zone. If a cable repair is carried out, which one is the best estimate for when the cable will be repaired and fully functioning again?

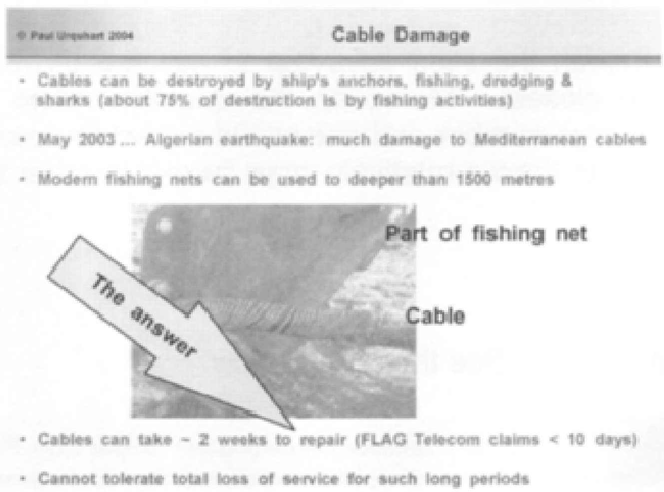
A- 02:00 hours; 2nd November

B- 08:00 hours; 3rd November

C- 20:00 hours; 4th November

D- 08:00 hours; 14th November

The required answer is D. See the slide below, which indicates that around fourteen days would be required for a cable ship to travel to the site of the problem and perform a repair:



Question 16 (3 p.)

Which of these categories of optical communications network is currently experiencing the most intense research and development interest by the world's telecommunications operators? [The word "currently" refers to the years 2006 and 2007.]

A- Sub-sea networks

B- Wide area terrestrial networks

C- Metropolitan area networks

D- Access networks

The required answer is D. Optical access networks are currently regarded as the "hot topic" in optical communications. About ten years ago fibre to the home (FTTH) was considered to be rather speculative. However, nearly all of the world's major telecommunications operators and equipment suppliers have now started to take a serious interest in the subject. For the past two years, at least, FTTH has been the dominant theme at the major international optical telecommunications conferences.

Question 17 (3 p.)

A passive optical network is to be used to serve 16 domestic customers which are all less than 20 km from the local exchange. The multiplexing scheme is time division multiple access (TDMA) in which the aggregate data rates are 622 Mbit/s downstream and 155 Mbit/s upstream. Where should the dispersion compensating fibre(s) be placed in the network?

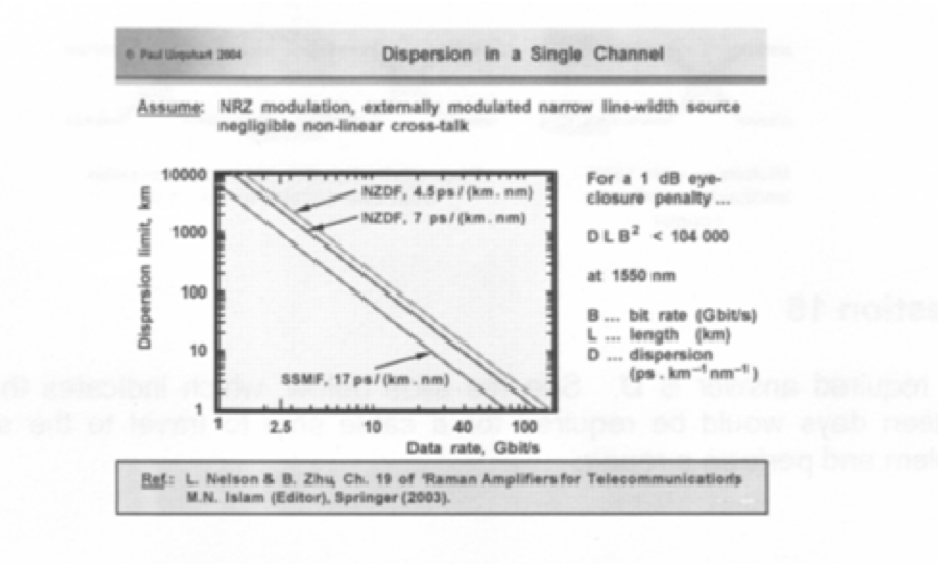
A- Nowhere: DCF is not required

B- In the ONUs in the customer premises

C- In the remote node next to the power splitter

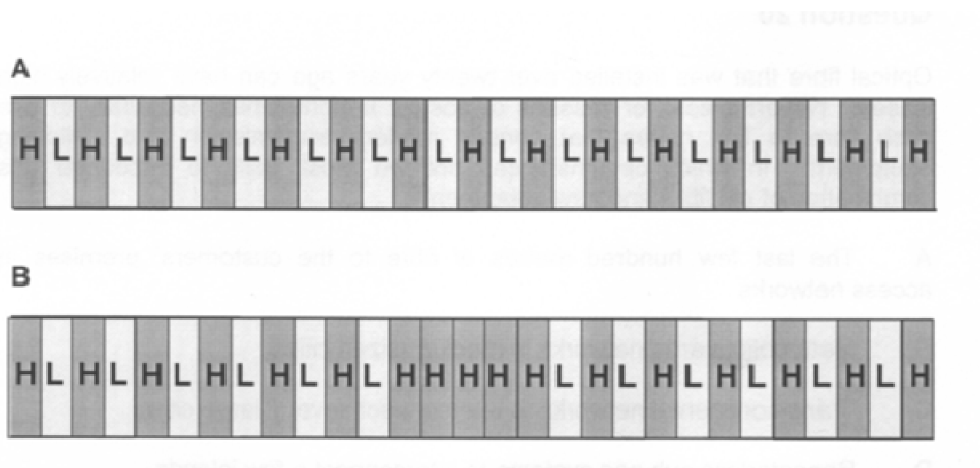
D- In the local exchange building

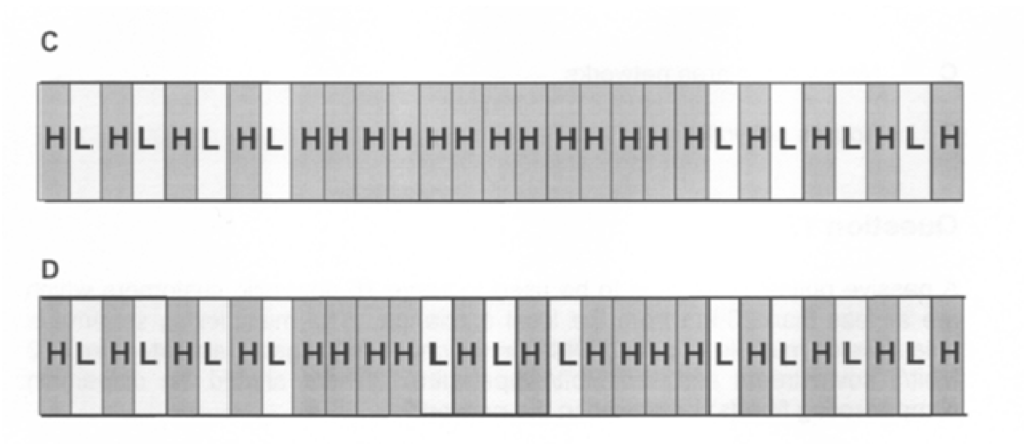
The required answer is A. If you read through the lecture slides on optical access networks, DCF is not mentioned. There are two reasons. Firstly, according to the ITU standard G.983.1, when there is no amplification, the transmission spans are limited to 20 km and this is not very long. Secondly, according to the same standard, the data rate is no higher than 622 Mbit/s. The combination of the short span and low transmission length means that DCF is not required. The slide below indicates how unimportant dispersion is at low data rates and short spans:



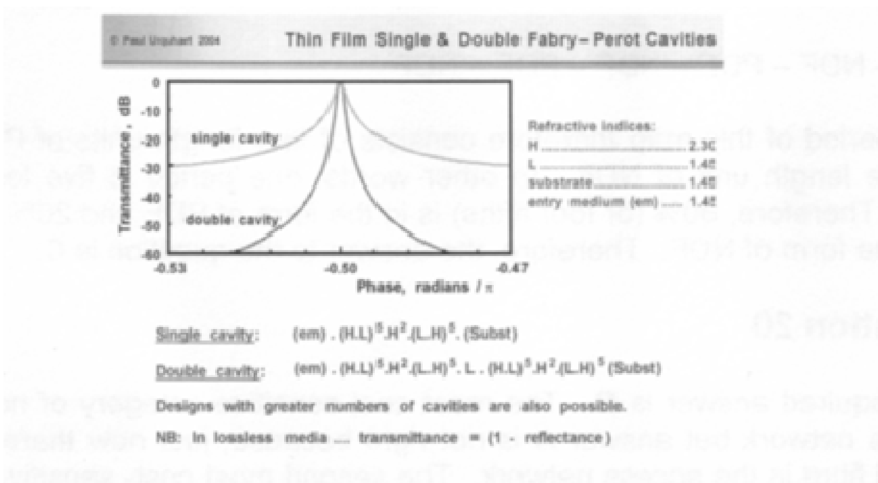
Question 18 (3 p.)

A thin film optical filter is to be used as a single channel transmission filter in a WDM network. It consists of two types of glass layers deposited on a substrate: H is tantalum pentoxide (Ta_20_5) with a refractive index of 2.065, while L is silica ($Si0_2$) with a refractive index of 1.465. Each layer has an optical thickness of one quarter of a wavelength. Which of the following structures is most likely to be a suitable filter for channels that are spaced close together?





The required answer is D. The structure is a two-cavity Fabry Perot structure See the slide below:



Question 19 (3 p.)

An optical fibre transmission system consists of alternating spans of positive dispersion fibre (PDF) and negative dispersion fibre (NDF). All of the fibre is cabled and the dispersion map is periodic. The dispersion coefficients are DPDF = + 6 ps / (km . nm) and DNDF = - 24 ps / (km . nm). What are the percentages of the two types of fibres in the cable?

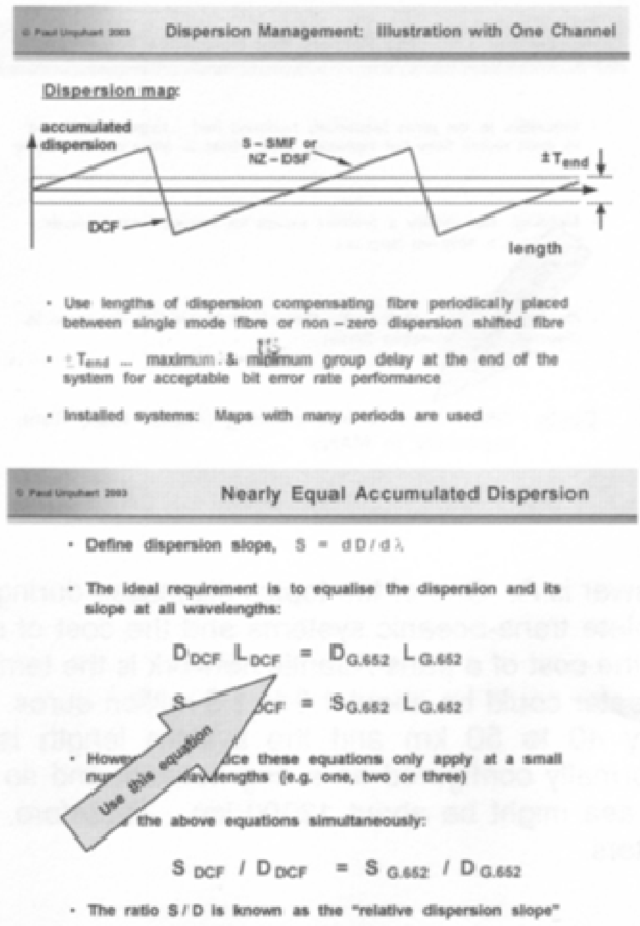
A- PDF: 25% , NDF: 75%

B- PDF: 75% , NDF: 25%

C- PDF: 80% , NDF: 20%

D- PDF: 66.7% , NDF: 33.3%

The required answer is C. See the two slides below to understand how dispersion compensation is carried out:



The equation refers to a specific kind of positive dispersion fibre (PDF): G.652. However, it is general and applies to operation with other kinds. If we use it together with the numbers given in the question, we find that the ratio of the lengths must be 24 / 6. This means that on average there is four times as much PDF as NDF. So what we have is a dispersion map consisting of ...

PDF – NDF – PDF – NDF – PDF – NDF .....

One period of this map therefore consists of four length units of PDF, followed by one length unit of NDF. In other words, one period is five length units in total. Therefore, 80% (or four fifths) is in the form of PDF and 20% (or one fifth) is in the form of NDF. Therefore. the answer to the question is C.

Question 20 (3 p.)

Optical fibre that was installed over twenty years ago can have relatively high losses. Nevertheless, for reasons of cost, it is sometimes necessary to use such fibre to link nodes that contain modern transmission and switching equipment. In which circumstances are we most likely to encounter this combination of old fibre and new equipment?

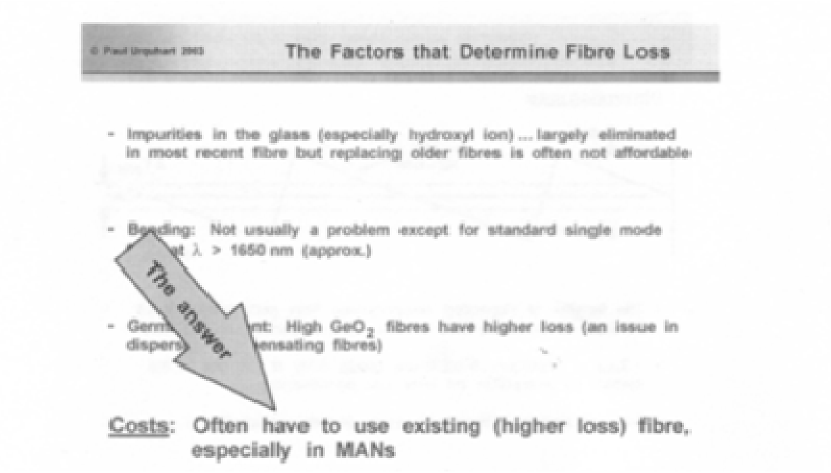
A- The last few hundred metres of fibre to the customers' premises in access networks

B- Metropolitan area networks in medium-sized cities

C- Trans-continental networks to interconnect several large cities

D- Repeaterless sub-sea systems to interconnect a few islands

The required answer is B. The most cost-sensitive category of network is the access network but answer A is not right because, just now there is very little optical fibre in the access network. The second most cost- sensitive category is the metropolitan area network and it is here that one is most likely to encounter the combination of new terminal equipment and old optical fibre linking the terminals. In contrast, sub-sea and longer span terrestrial networks are less cost sensitive because they carry much higher capacities and the costs are shared between many customers. See the slide below:



Question 21 (4 p.)

A new trans-Atlantic optical system is to be installed in the form of a forty-channel WDM self-healing ring network. There will be two terminal stations in Western France and two terminal stations on the East coast of the USA. Its total cost will be 1.5 billion Euros. How would you expect the money to be spent? See the table below in which all costs are in Euros:

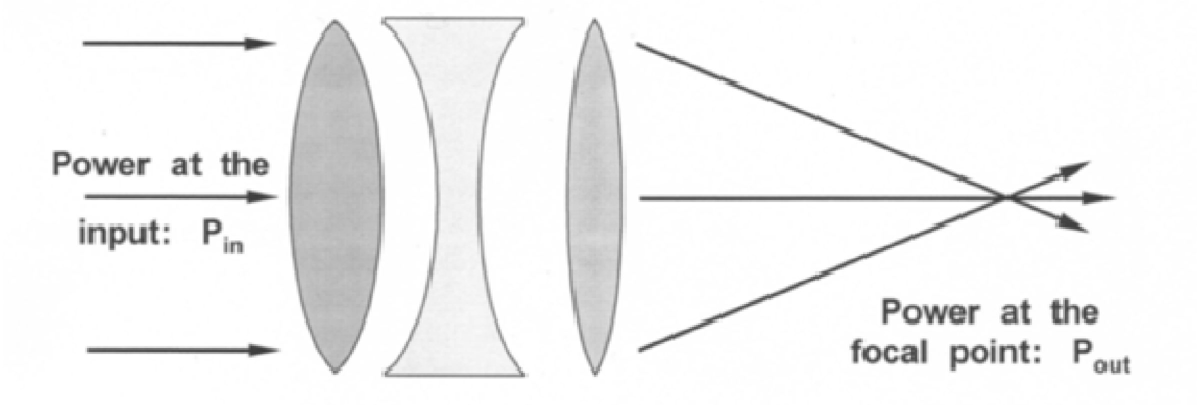
Answer	Total cost of the repeaters	Total cost of the four terminal stations	All other costs
A	400 million	700 million	400 million
B	1000 million	100 million	400 million
C	200 million	200 million	1100 million
D	100 million	1100 million	300 million

The required answer is A. One of the topics discussed during your lectures was the cost of complete trans-oceanic systems and the cost of repeaters. Slightly less than half of the cost of a trans-Atlantic network is the terminal stations. The cost of each repeater could be about 1.0 to 1.5 million euros. Typically, there is a repeater every 40 to 50 km and the system length is about 6000 km. However, it is normally configured as a ring network and so the total length of cable under the sea might be about 12000 km. Therefore, one would expect about 300 repeaters.

By using all of these facts together answer A would seem to be a reasonable cost estimate. (The 400 million for "all other costs" would include the cost of the cables, geological surveys, cost of installing and testing the system, etc.)

Question 22 (4 p.)

The type of lens that is shown here is called a triplet (because it is a compound lens consisting of three elements). It is used to correct for the main types of optical aberration.



Assume for simplicity that the reflectance from the interface between air and glass is always 4%. If no anti-reflection coatings are used, what is the power at the focus?

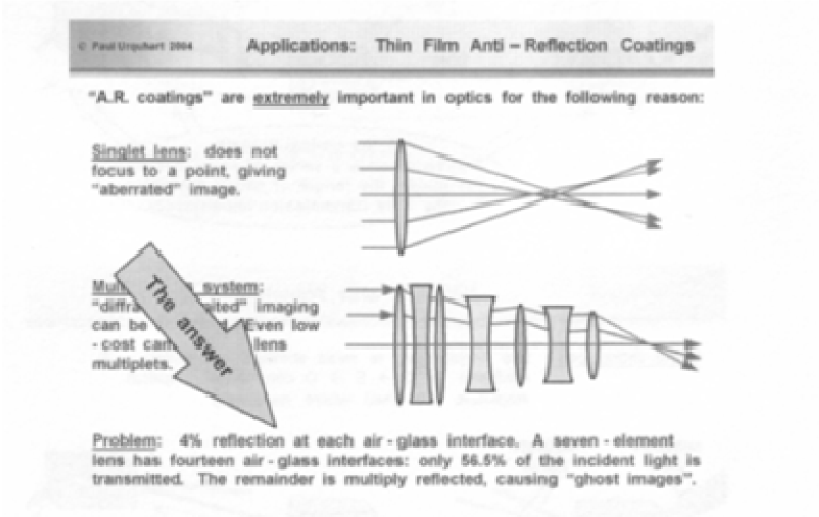
A- Pout = [1- (3 x 0.04)] Pin = 0.88 Pin

B- Pout = [1- (6 x 0.04)] Pin = 0.76 Pin

C- Pout = $(1 – 0.04)^3$ Pin = 0.885 Pin

D- Pout = $(1 – 0.04)^6$ Pin = 0.783 Pin

The required answer is D. Compare with the following slide:



In the question there are six air-glass interfaces because there are three lens elements. At each interface (100 – 4)% = 96% of the light is transmitted and one has to raise this to the power of six, as in answer D.

Question 23 (4 p.)

Which statement about metropolitan area fibre networks (MANs) is False?

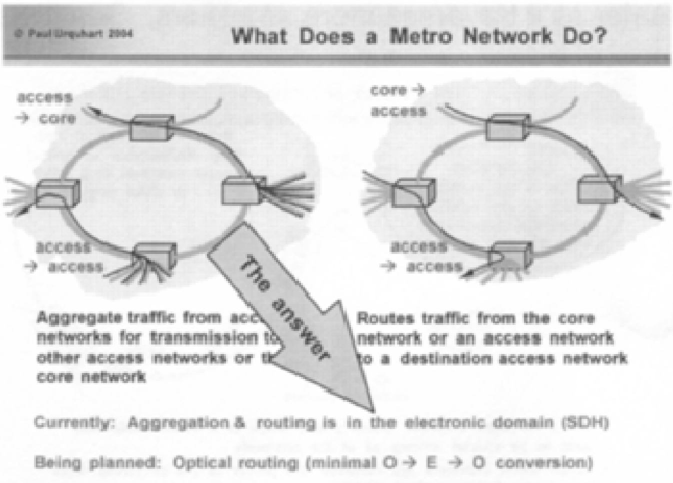
A- Optical MANs are used to transport many data protocols and in this way satisfy the needs of a large variety of end customers

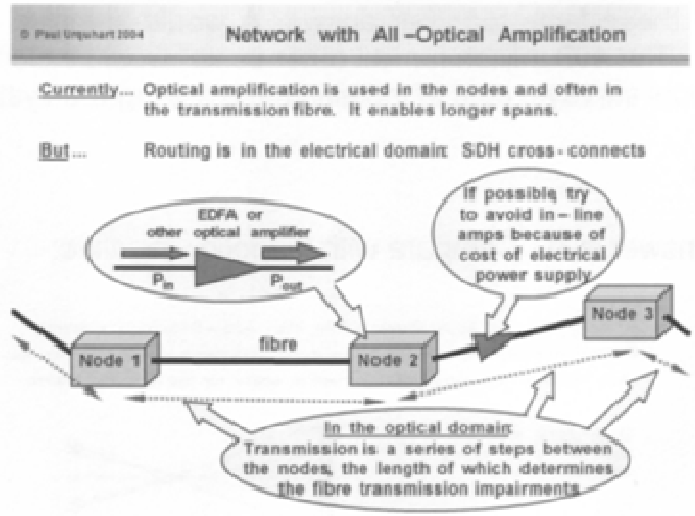
B- The metropolitan networks that are currently installed use all-optical routing with wavelength conversion to reduce wavelength assignment difficulties

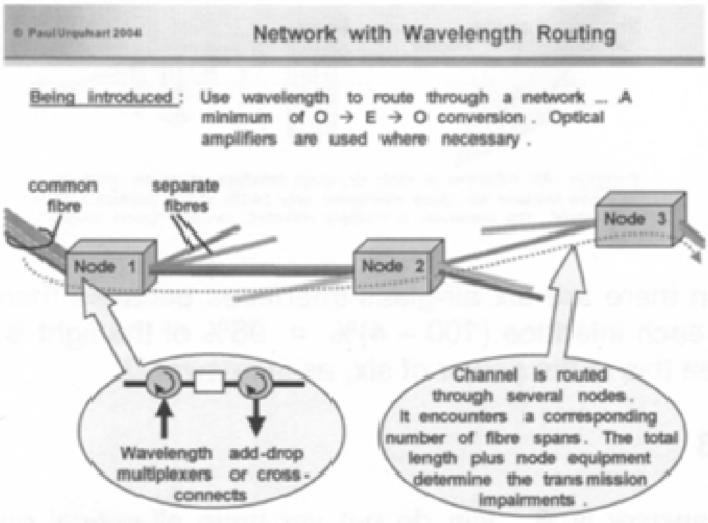
C- Data carried on MANs are highly bursty and the traffic statistics do not conform to traditional models that were used in the past for telephony

D- The current generation of MANs is SDH – dominated but it is rapidly evolving to WDM, which may include SDH on some or all of the channels

The required answer is B. We do not yet have all-optical routing and cross-connects in the MANs that have been installed. However, many laboratories round the world are designing and testing such systems. Wavelength conversion has been known about for several years but operators are not yet ready to use it in their networks. See the slides below:

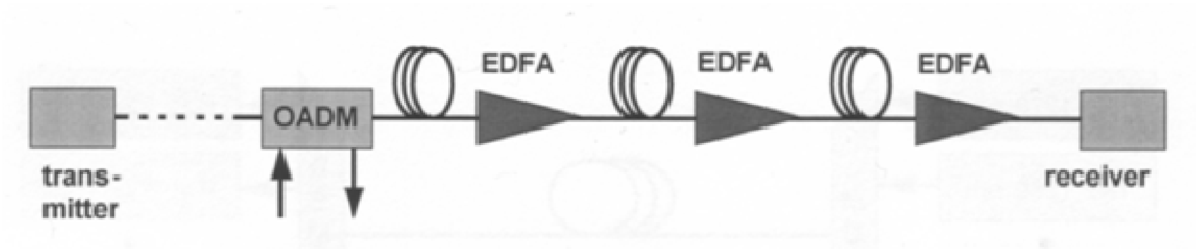

© Paul Urquhart 2004
What Does a Metro Network Do?
access → core
core → access
access → access
access → access
The answer
Aggregate traffic from access networks for transmission to other access networks or the core network
Routes traffic from the core network or an access network to a destination access network
Currently: Aggregation & routing is in the electronic domain (SDH)
Being planned: Optical routing (minimal O → E → O conversion)


© Paul Urquhart 2004
Network with All-Optical Amplification
Currently... Optical amplification is used in the nodes and often in the transmission fibre. It enables longer spans.
But... Routing is in the electrical domain: SDH cross-connects
EDFA or other optical amplifier
P_in
P_out
If possible, try to avoid in-line amps because of cost of electrical power supply
Node 1
fibre
Node 2
Node 3
In the optical domain:
Transmission is a series of steps between the nodes, the length of which determines the fibre transmission impairments


© Paul Urquhart 2004
Network with Wavelength Routing
Being introduced: Use wavelength to route through a network ... A minimum of O → E → O conversion. Optical amplifiers are used where necessary.
common fibre
separate fibres
Node 1
Node 2
Node 3
Wavelength add-drop multiplexers or cross-connects
Channel is routed through several nodes. It encounters a corresponding number of fibre spans. The total length plus node equipment determine the transmission impairments.

Question 24 (4 p.)

An optical fibre network includes a reconfigurable optical add drop multiplexer (OADM) followed by a chain of erbium doped fibre amplifiers (EDFAs), as shown below:



What severe problem can be caused when the OADM is reconfigured so that a larger number of channels is dropped and inserted?

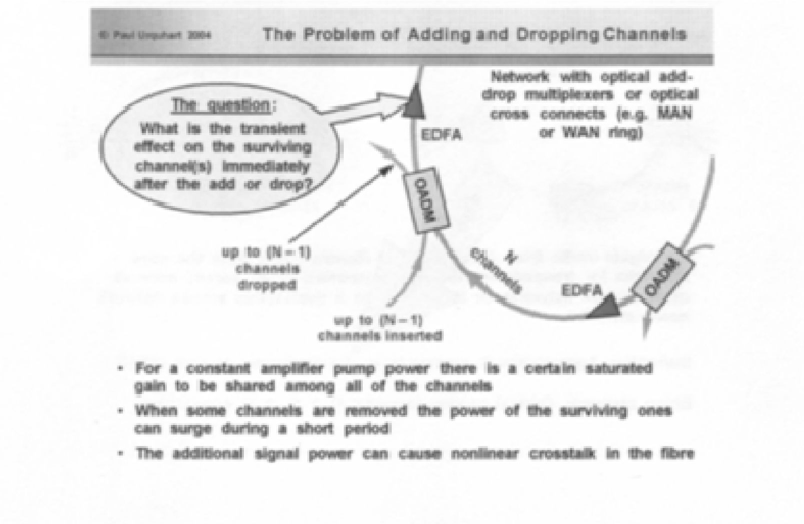
A- When the OADM is being reconfigured a larger number of channels arrives at the receiver and this increases the non-linear cross-talk

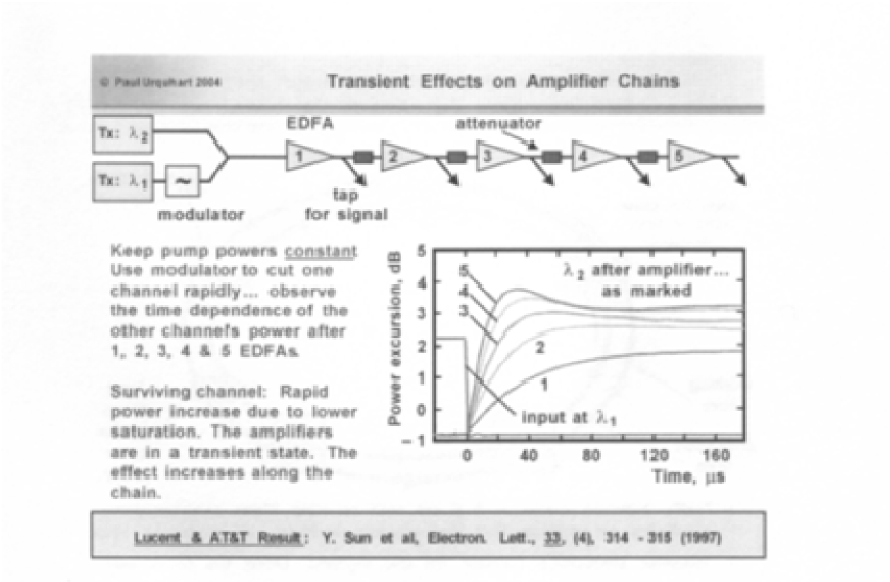
B- The new channel wavelengths that are inserted can be outside the gain bandwidth of the amplifiers

C- When the OADM is reconfigured there is a short term change in the optical signal. As a result, the gains of the EDFAs increase and there is a sudden rise in the optical power

D- When the OADM is reconfigured it consumes electrical power and there can be a short term reduction in current to the EDFAs, causing the gain to drop

The required answer is C. There will be a power surge immediately after reconfiguring the channels that pass through the OADM and it becomes progressively greater as it traverses more amplifiers. See the following slides:

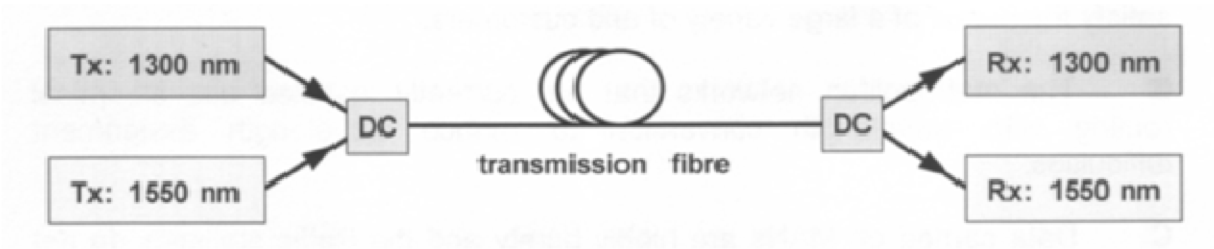




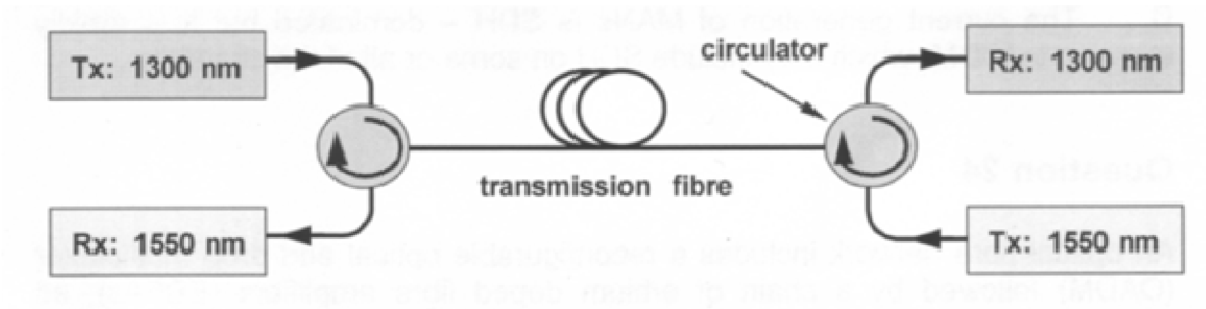
Question 25 (4 p.)

Four diagrams are shown below. Which one is the best representation of wavelength diplexing, as used in short span and low cost transmission systems? DC = multiplexing directional coupler, Tx = transmitter, Rx = receiver.

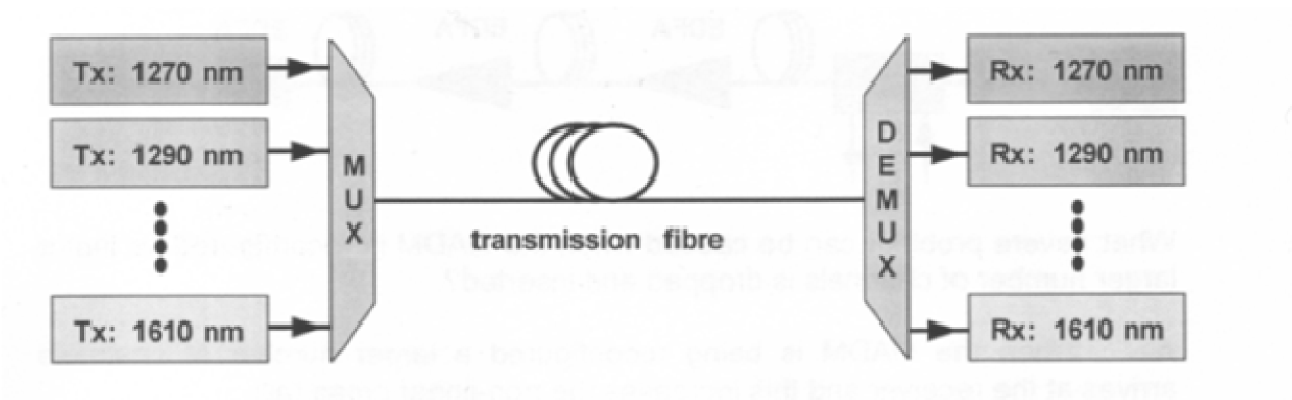
A


Tx: 1300 nm
Tx: 1550 nm
DC
transmission fibre
DC
Rx: 1300 nm
Rx: 1550 nm

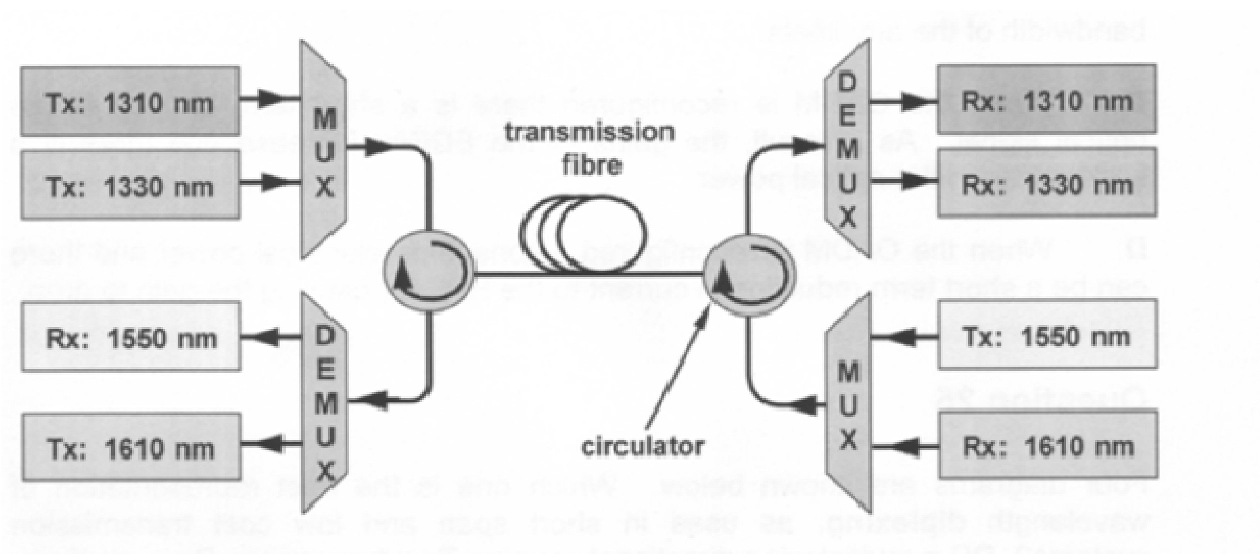
B


Tx: 1300 nm
Rx: 1550 nm
circulator
transmission fibre
Rx: 1300 nm
Tx: 1550 nm

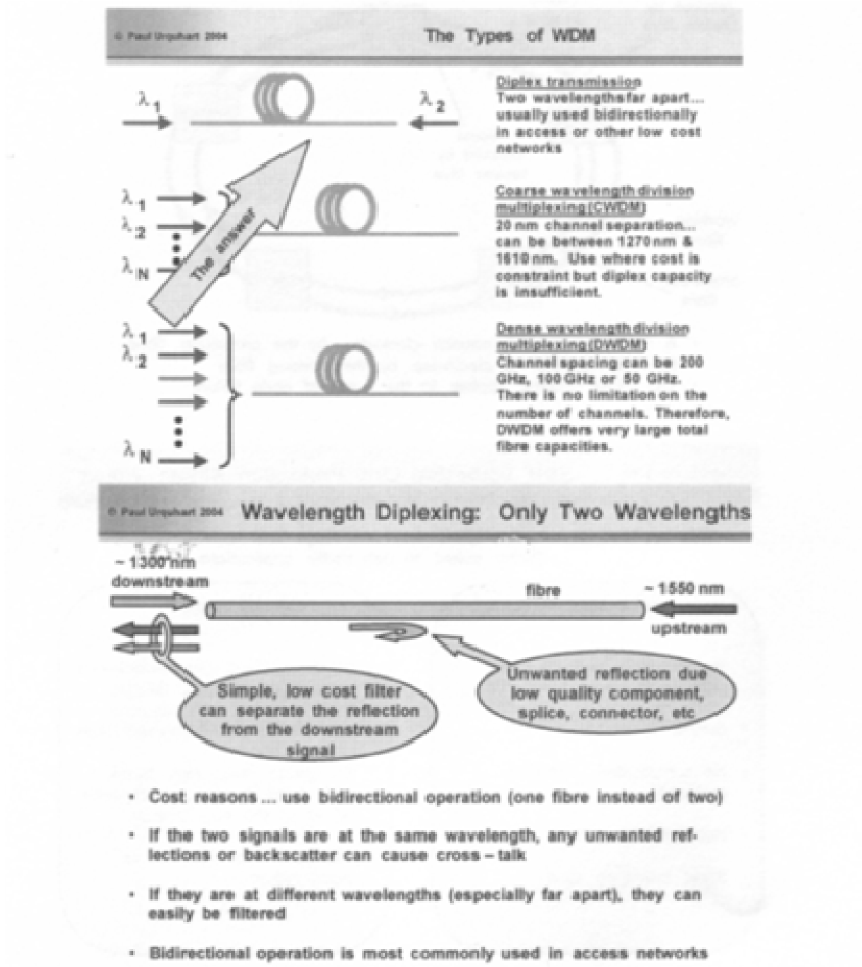
C


Tx: 1270 nm
Tx: 1290 nm
Tx: 1610 nm
MUX
transmission fibre
DEMUX
Rx: 1270 nm
Rx: 1290 nm
Rx: 1610 nm

D


Tx: 1310 nm
Tx: 1330 nm
MUX
Rx: 1550 nm
Tx: 1610 nm
DEMUX
transmission fibre
circulator
DEMUX
Rx: 1310 nm
Rx: 1330 nm
MUX
Tx: 1550 nm
Rx: 1610 nm

The required answer is B. See the slides below:



Question 26 (4 p.)

The acronym SNCP means "Sub-Network Connection Protection" and it refers to a type of synchronous digital hierarchy (SDH) self-healing ring. Which of these statements about two-fibre SNCP rings is wrong?

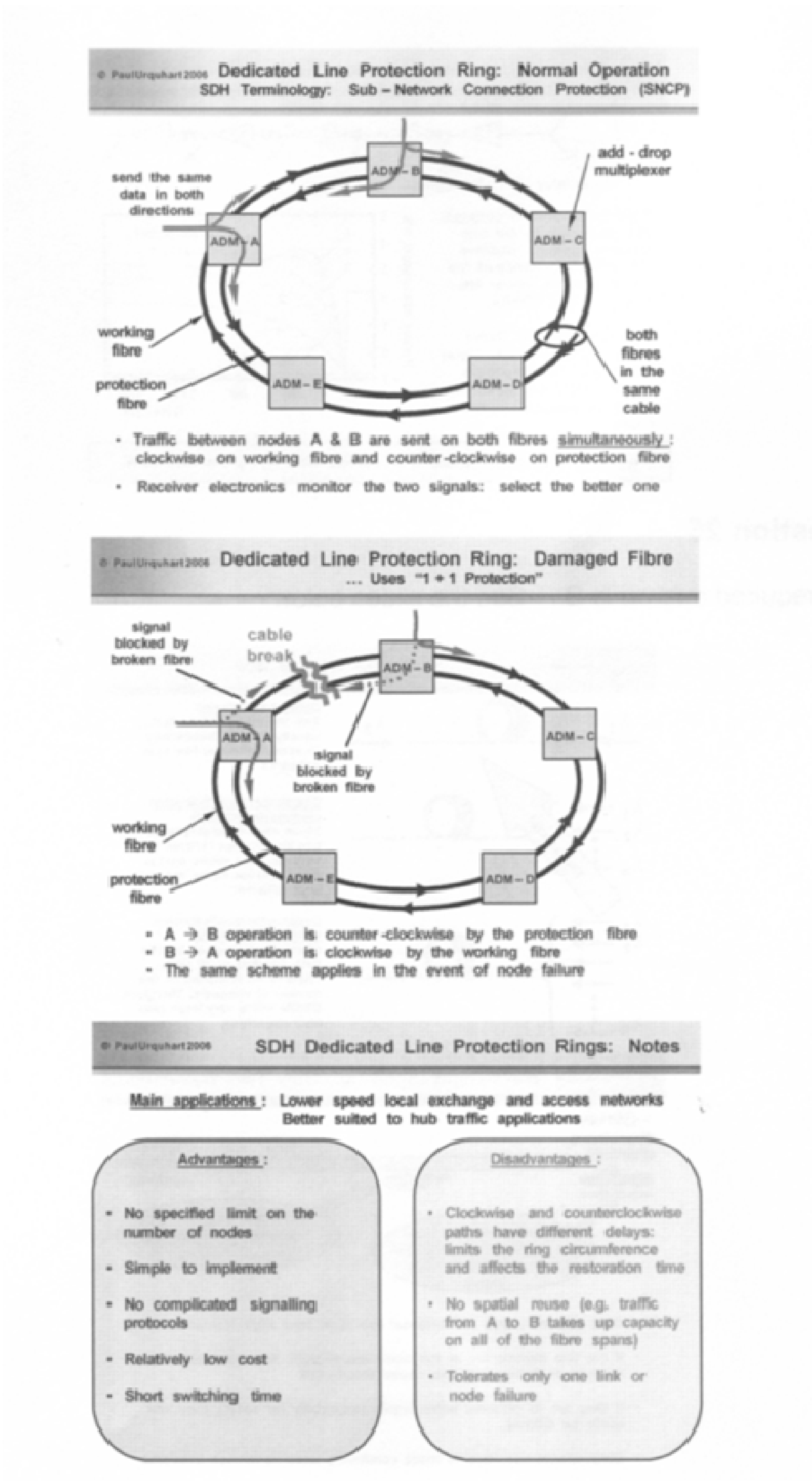
A- Identical traffic propagates round the ring: Clockwise on one fibre and counter-clockwise on the other fibre

B- The protection protocols (and associated software) are more straightforward to implement than in the two fibre Multiplex Section – Shared Protection Ring (MS-SPRing)

C- During normal operation each fibre operates at 50% of its capacity. The remaining capacity can be used for low priority traffic, which can be sacrificed in the event of fibre damage

D- The SNCP Ring tolerates only one link failure or one node failure. If there is more than one failure, traffic is completely lost at one or more points on the network

The required answer is C. See the slides below:



Question 27 (4 p.)

Which of these is the best description of the metropolitan area networks that are being installed in Western Europe just now?

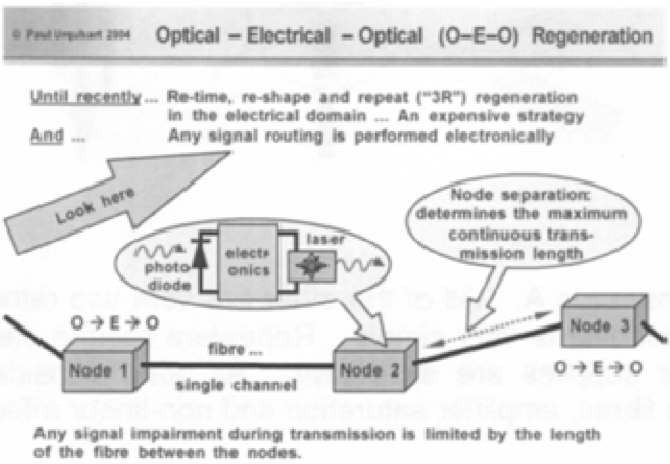
A- The links between the nodes are point-to-point with electronic regeneration in the nodes. The fibres are single channel at either 155 Mbit/s or 622 Mbit/s. The routing is entirely based on synchronous digital hierarchy (SDH) cross-connects

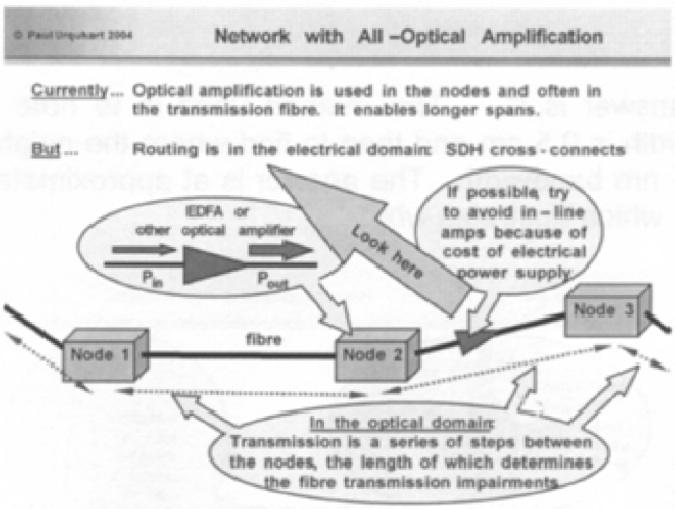
B- The networks are mainly self-healing rings with a small number of wavelength division multiplexed (WDM) channels in the C-band. The data rates are commonly 2.5 Gbit/s or 10 Gbit/s per channel and there are optical amplifiers in the nodes. Nevertheless, the routing is mainly performed by SDH cross-connects

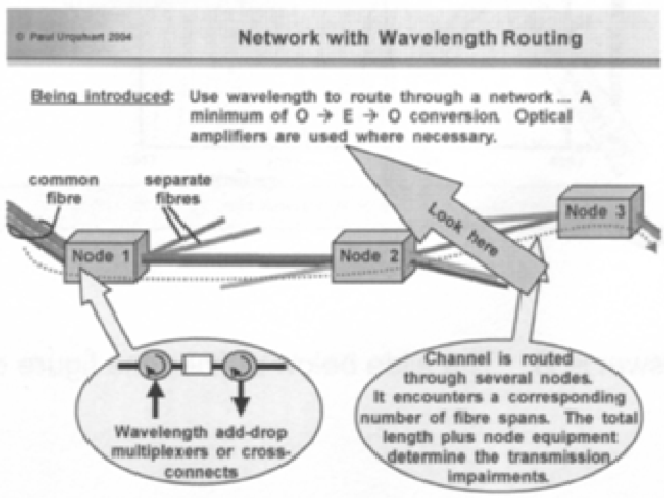
C- The networks are nearly all self-healing rings with WDM channels that are mainly at 10 Gbit/s in both the C- and L-bands. Both C- and L-band optical amplifiers are used throughout the network. The routing is mainly performed by reconfigurable optical add-drop multiplexers. SDH continues to be used because of its ability to provide useful network management functions

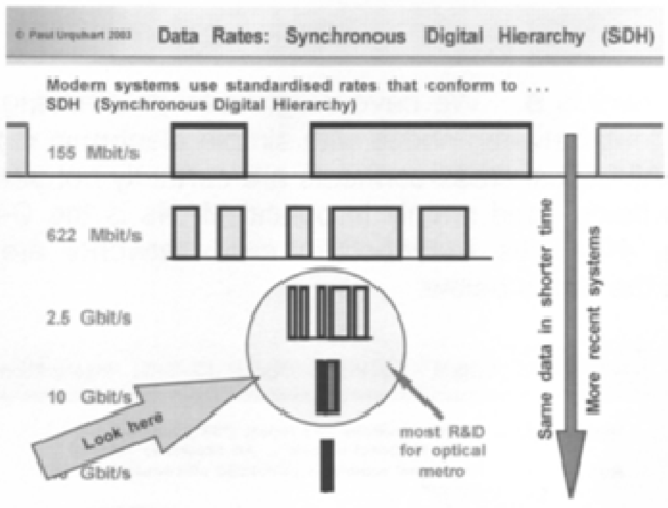
D- The networks are a mixture of self-healing rings and meshes with WDM channels in the S-, C- and L-bands. A number of amplifier technologies are required to span the spectrum but fibre Raman amplifiers are becoming increasingly important. Routing is mainly performed by optical cross-connects. The data rates are a mixture of 10 Gbit/s and 40 Gbit/s.

The required answer is B. We have progressed past having a series of point-to-point connections between nodes with simple electronic regeneration but not by very much. All-optical cross-connects are certainly not yet being used. The amplifier that is being used mainly in optical MANs is the C-band EDFA. For the time being, 40 Gbit/s metropolitan area networks are confined to the laboratory. See the slides below:


© Paul Urquhart 2004
Optical – Electrical – Optical (O–E–O) Regeneration
Until recently ... Re-time, re-shape and repeat ("3R") regeneration in the electrical domain ... An expensive strategy
And ... Any signal routing is performed electronically
Look here
Node separation: determines the maximum continuous transmission length
photo diode
electronics
laser
O → E → O
Node 1
fibre ...
single channel
Node 2
Node 3
O → E → O
Any signal impairment during transmission is limited by the length of the fibre between the nodes.


© Paul Urquhart 2004
Network with All –Optical Amplification
Currently ... Optical amplification is used in the nodes and often in the transmission fibre. It enables longer spans.
But ... Routing is in the electrical domain: SDH cross - connects
EDFA or other optical amplifier
P_{in}
P_{out}
Look here
If possible, try to avoid in – line amps because of cost of electrical power supply
Node 1
fibre
Node 2
Node 3
In the optical domain:
Transmission is a series of steps between the nodes, the length of which determines the fibre transmission impairments


© Paul Urquhart 2004
Network with Wavelength Routing
Being introduced: Use wavelength to route through a network ... A minimum of O → E → O conversion. Optical amplifiers are used where necessary.
common fibre
separate fibres
Node 1
Node 2
Node 3
Look here
Wavelength add-drop multiplexers or cross-connects
Channel is routed through several nodes. It encounters a corresponding number of fibre spans. The total length plus node equipment determine the transmission impairments.



Question 28 (4 p.)

Which of the following is the best explanation of why sub-sea cable operators use repeaterless systems when it is possible to do so?

A- If there are no active components under the sea, such as the pump lasers for optical amplifiers, it is not necessary to supply electrical power. Therefore. the costs are lower.

B- Repeaterless systems have relatively short spans and therefore it is possible to use low loss fibres, such as "pure silica core fibre". These fibres reduce the need for submerged repeaters and so the costs are lower.

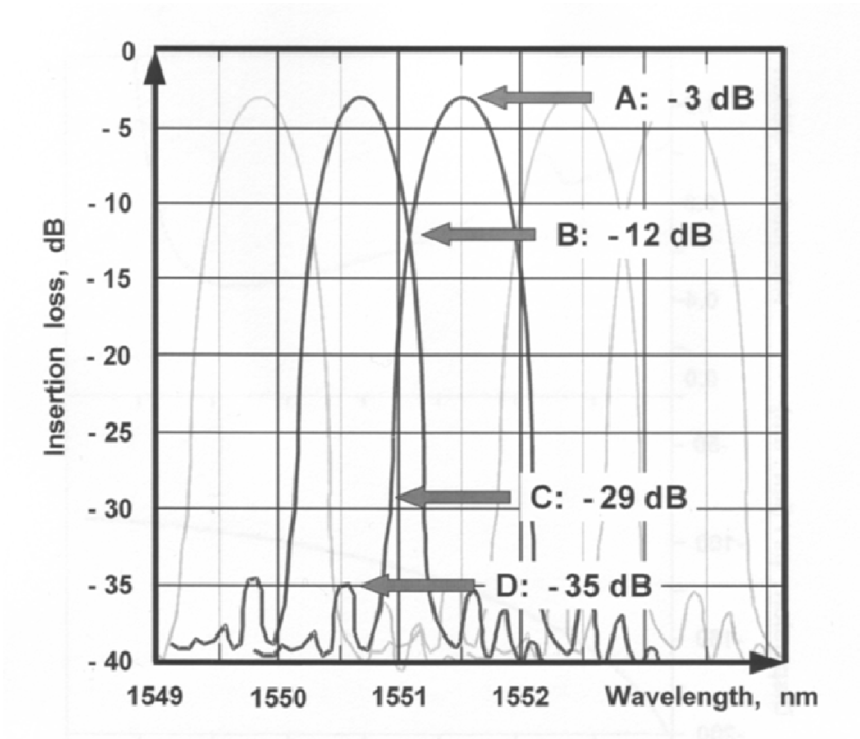
C- In repeaterless systems operators use low dispersion fibre. Therefore, dispersion compensating fibre (DCF) is not required. DCF has a high loss and if it is not used, the expensive repeaters can be eliminated.

D- When there are no submerged repeaters, it is possible to ensure that the optical power of the channels remains low. Therefore non-linear optical crosstalk is reduced. The compensation of non-linear cross talk can be very expensive.

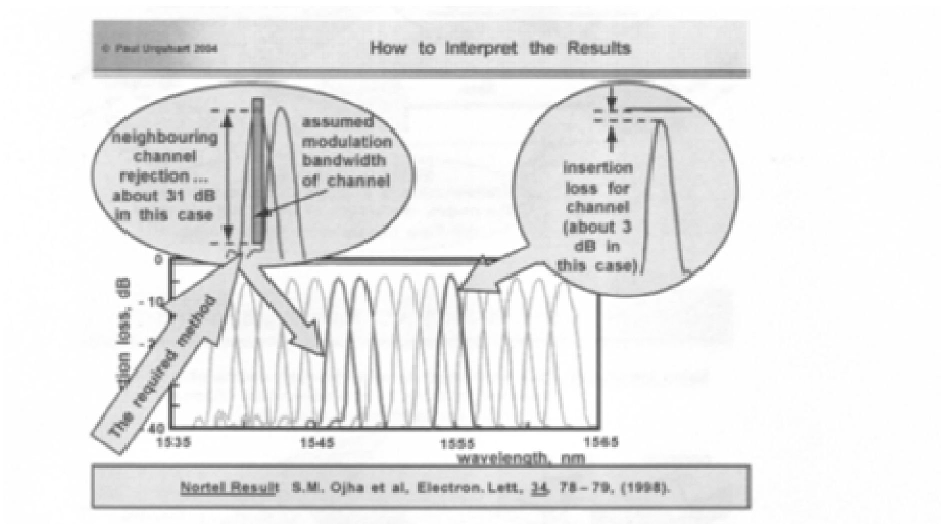
The required answer is A. All of the other answers use rather confused logic. The correct reasoning is very simple. Repeaters require electrical power and electrical power supplies are expensive. All other considerations, such as special low loss fibres, amplifier saturation and non-linear effects in the fibre are secondary.

Question 29 (4 p.)

The diagram below shows the transmission response of some of the channels of a 1 x N arrayed waveguide grating (AWG). The AWG is operating in a transmission system in which the modulation bandwidth of each channel is 0.5 nm. Concentrate on the two bold curves. What is the neighbouring channel isolation?



The required answer is C. The method used is to note that the required channel bandwidth is 0.5 nm and then to find where the neighbouring channels overlap this 0.5 nm bandwidth. The answer is at approximately − 29 db. See the slide below, which illustrates why:



Question 30 (4 p.)

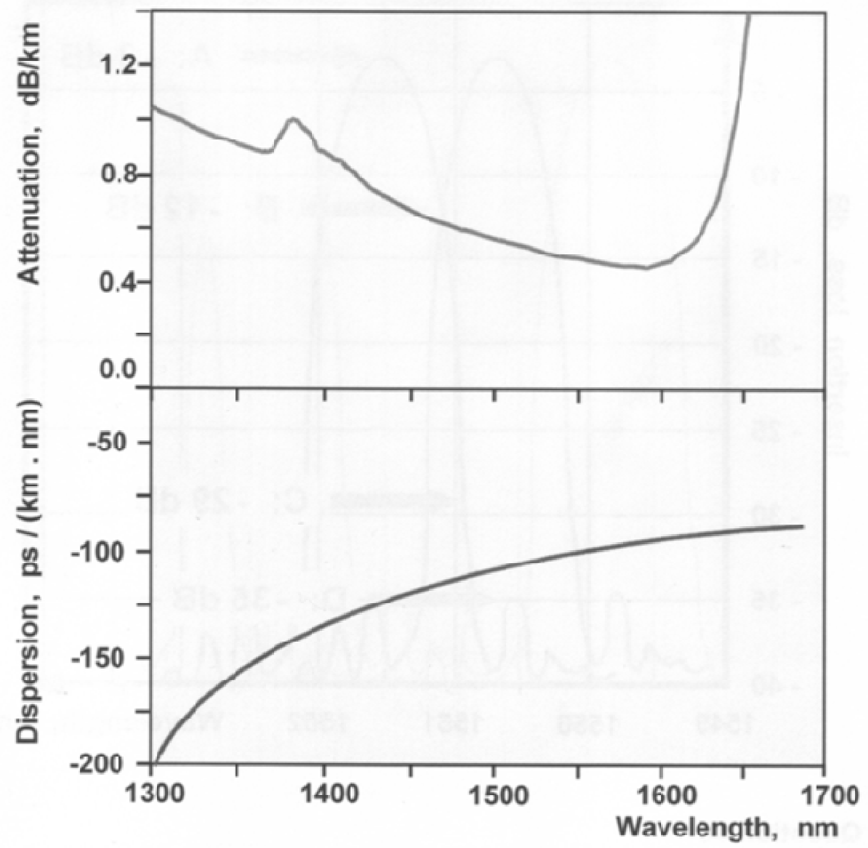
The figure of merit (FoM) of a dispersion compensating fibre is a number that provides a means of assessing how effectively it compensates for the dispersion of a transmission fibre and how much additional loss it introduces in the process. The graphs on the following page are for a dispersion compensating fibre. What is its FoM at 1550 nm? [Note that the horizontal axes are both wavelength in nanometres.]

A- 50 ps / (nm . dB)

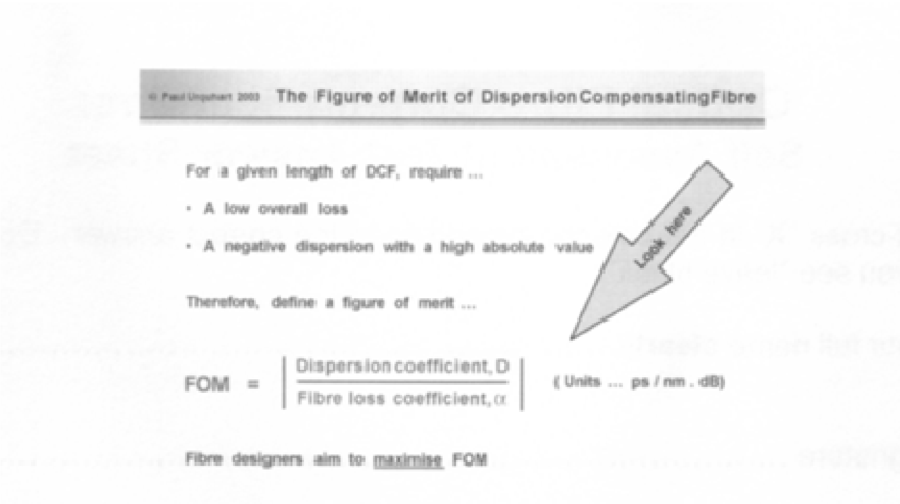
B- 200 ps / (nm . dB)

C- 500 ps / (nm . dB)

D- 0.005 ps / (nm . dB)



The required answer is B. The slide below defines the figure of merit:



What you then must do is to use the two graphs that are given in the question. The top one tells you that the loss at 1550 nm is 0.5 dB/km and the bottom one tells you that the dispersion coefficient at 1550 nm is 100 ps / (km . nm). Divide one by the other, according to the definition given above to show that the required value is FoM = 200 ps / (km . dB).