SPC Network

Report for Jersey Competition and Regulatory Authority

Dark fibre access in the Business Connectivity Market: Technical considerations, international precedent and potential remedy design

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1 EXECUTIVE SUMMARY

1.1 Context and purpose

The Jersey Competition Regulatory Authority (the Authority) is conducting a review of business connectivity markets in Jersey and is considering dark fibre access as an *ex ante* remedy in the event of a finding of significant market power on one or more operators. Dark fibre is defined as:

> *A dedicated fibre optic path where the circuit provider has no active electronics attached at either end. The access seeker is able to attach their own active equipment directly to the ends of the fibre path and "light" it at whatever speed they choose and in whatever configuration they choose, within the limitations of what is technically feasible for that particular fibre.*

The purpose of this report is to provide more detail on the technical considerations for a dark fibre access remedy, outline the international precedents and set out the potential scope of the remedy, should the Authority decide to impose it as an outcome of the market review. This report does not address the benefits of dark fibre access and so should be read alongside the Business Connectivity Market Review Draft Decision consultation[1].

1.2 Key findings

The key findings of this report for each of the areas considered are as follows:

Technical considerations

Dark fibre is a dedicated fibre-optic path where the circuit provider has no active electronics attached at either end. The access seeker can combine multiple fibre paths.

The fibre path can be either "single fibre working", in which a single fibre strand transmits data in both directions using different wavelengths, or "dual fibre working", in which separate strands carry data in each direction.

Fibre circuits can be deployed in a number of different ways, including:

[1] See document no: JCRA 20/20

- Between two customer sites (End-to-end);
- Between two exchange buildings (Interexchange); and
- Between a customer end and a local interconnection point on the provider's network (tail circuit). This deployment may require actual or virtual co-location and associated facilities, such as power.

Standard transceiver modules can cope with distances if up to 80km, so it is unlikely there will be any practical distance limitations on Jersey.

The service demarcation point (between the circuit provider and the access seeker) will be a fibre optic connection at each end of the fibre path (or two such connectors if dual fibre working).

There will be a need for the service provider to publish a Reference Offer, a Service Level Agreement and Service Legal Guarantee.

International precedents

Two European countries have introduced a dark fibre access remedy in their equivalent of the business connectivity market: Austria and the UK. However, other countries have introduced dark fibre as an access remedy in wholesale broadband access and wholesale local access markets. Certain key lessons can be drawn from each of the two business connectivity examples.

Austria's decision to introduce dark fibre was driven by demand from the mobile operators for more flexible backhaul. Dark fibre was first introduced in the 2014 market review without any major objections from the dominant operator: A1 Telekom Austria. However, the price was set too high and so no dark fibre circuits were sold. When the regulator reviewed the market in 2018 the price of dark fibre was lowered and some demand is now being seen in the market.

The UK has had an inconsistent approach to dark fibre since it was first proposed as a remedy in the business connectivity market in 2016. There were two key inconsistencies: first, the proposed product changed from dark fibre access circuits to interexchange circuits and, secondly, the price approach changed from "active minus" to cost orientation. The inconsistency is, in part, caused by Ofcom switching emphasis to duct and pole access, with dark fibre mandated only where physical access is not effective.

SPC Network suggests that the Authority should take account of these lessons in its implementation of dark fibre and ensure a consistent approach to the remedy and to set prices at a level that is attractive to access seekers but which does not prevent JT from earning a reasonable return on its fibre network.

Potential scope of a dark fibre access remedy

The table below sets out the potential scope of the dark fibre access remedy, including where further consultation with stakeholders may be required.

Parameters of the dark fibre access remedy	SPC Network comment
Parity with active wholesale products	A dark fibre access only remedy would be in line with best practice and allow competition in downstream wholesale and retail markets. No customer group is likely to suffer significant harm from the removal of regulated wholesale access to active leased lines. Wholesale access should therefore be at dark fibre access level only.
Migration to dark fibre access	Regulated access to active wholesale products should only be withdrawn once a fit-for-purpose dark fibre access remedy is in place and sufficient time has elapsed for migration. The time period required would be agreed at a later date.
Scope of dark fibre access	Dark fibre access could be implemented for end-to-end connections, tail circuits or interexchange circuits as seen fit. The preferred approach should be related to market demand and the costs of implementation. For examples, if Other Licenced Operators (OLOs) require dark fibre tail circuits a co-location obligation would be needed and included in the dark fibre access Reference Offer.
Provision of new infrastructure	Where a dark fibre is requested to a location with no fibre at present, the dominant firm should be required to provide this fibre but be allowed to charge an excess construction charge over and above a fixed amount.
One or two fibre circuits.	The regulated operator should be required to provide both one and two fibre circuits.
Provisioning, repair and migration	Provisioning of dark fibre should follow the same process as in place for wholesale active circuits. Fault detection and repair will be the primary responsibility of the OLO and should only passed to the dark fibre provider once the fault has been triaged.
Accommodation and co-location	As noted above, dependent on the scope of dark fibre access, JT may need to provide accommodation and co-location. SPC Network understands that no such obligation is currently imposed on JT and so this would have to be developed.

Pricing	The Austrian experience suggest that the price of dark fibre access is important both to promote demand and to ensure that JT can recover its efficiently incurred costs. It will therefore be important for the Authority to set out how it intends to set the price of dark fibre access to ensure these objectives are met.

1.3 Report structure

The rest of this report is structured as follows:

- Section 2 provides a brief introduction to the report.
- Section 3 discusses the technical aspects of dark fibre access that need to be considered in developing the remedy.
- Section 4 draws on international experience of dark fibre access in the business connectivity market, in particular in Austria and the UK as the only two European countries that have introduced the remedy in this market explicitly.
- Section 5 sets out the potential scope of a dark fibre access remedy, should it be imposed as an outcome of the market review.

2 INTRODUCTION

The Jersey Regulatory and Competition Authority (the Authority) is currently conducting a review of the business connectivity market to determine what economic regulations to implement in the event that one or more operators is found to have Significant Market Power (SMP) in the relevant market. One option being considered is an obligation on any operator with SMP to provide access to dark fibre, which is defined as:

> *A dedicated fibre optic path where the circuit provider has no active electronics attached at either end. The access seeker is able to attach their own active equipment directly to the ends of the fibre path and "light" it at whatever speed they choose and in whatever configuration they choose, within the limitations of what is technically feasible for that particular fibre.*

Such an obligation, if imposed, would represent a significant change to the current form of regulated access to active circuits on a retail minus charging basis. The Authority has therefore commissioned SPC Network to consider the technical aspects of dark fibre access and the potential remedy design, should a dark fibre access obligation be introduced. The report draws on international precedents, where appropriate, and suggests some areas where further consultation with stakeholders would be beneficial.

This report does not consider the market and economic benefits and risks of dark fibre access which are discussed in the Business Connectivity Market Review (BCMR). Therefore, this report should be read in conjunction with the BCMR Draft Decision[2].

Without prejudice to the outcome of the market review process, this reports assumes that JT will continue to be the regulated operator in the business connectivity market and so refers to JT as the dark fibre provider and, where relevant, refers the JT network.

The views expressed in this report are those of SPC Network Ltd and not necessarily those of the Authority.

[2] See footnote 1

3 TECHNICAL CONSIDERATIONS

This section sets out the broad technical considerations that will need to be considered if a dark fibre access remedy is introduced on Jersey, including:

- A working definition of dark fibre;
- Local access and potential interconnection points;
- Route distance limitations;
- The need for physical and/or virtual co-location and associated services;
- Technical specifications of the fibres in the cable;
- Fibre connection points; and
- Service Level Agreements and Service Level Guarantees.

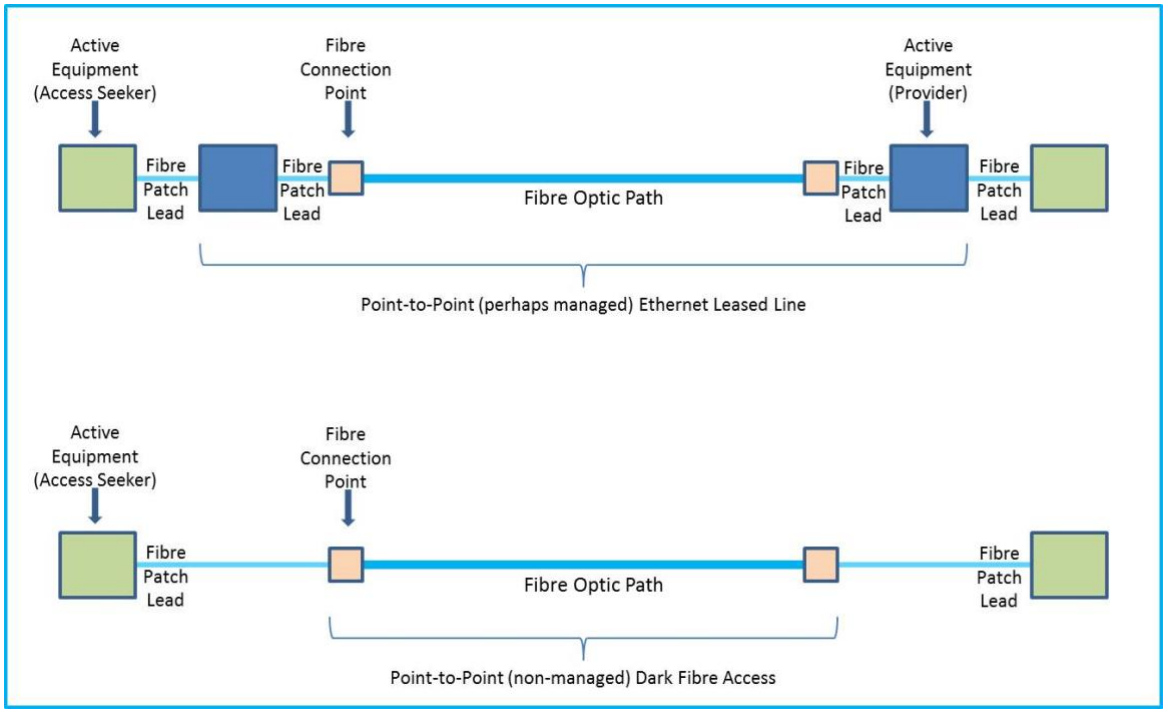
SPC Network has set out its views on these matters below, but proposes that, should a dark fibre access remedy be introduced, the regulated operator should publish its own dark fibre Reference Offer[3] to address these matters given the specifics of its network and any other specific considerations. SPC Network has not conducted an in-depth review of the JT network and so this section is written without specific knowledge of the network. However, to the best of SPC Network's knowledge there is nothing about the fibre network on Jersey that would preclude JT from offering dark fibre access.

3.1 Working Definition of Dark Fibre Access

A standard Ethernet leased line comprises of a fibre optic path between the two end points terminated on to active equipment owned, and potentially managed, by the circuit provider. Dark Fibre Access, on the other hand, is a dedicated point-to-point fibre optic path where the circuit provider has no active electronics attached at either end. The access seeker is thus able to attach their own active equipment directly to the ends of the fibre path and "light" it at whatever speed they choose, within the limitations of what is technically feasible for that particular fibre. This is illustrated for a point-to-point network, such as operated by JT, in Figure 1 below.

[3] A Reference Offer an offer document setting out matters relating to the price and terms and conditions under which a public carrier will permit interconnection to its public telecommunications network. (www.lawinsider.com)

Figure 1: Active and Dark Fibre Circuit Design



In addition to the simple point-to-point circuit configuration shown above, the access seeker could combine multiple fibre paths into other configurations, depending on what the access seeker is looking to achieve. One example would be to have two fibre paths between the same A and B ends in order to provide a degree of resilience. Two examples of more complex configurations are shown below: the first for a ring configuration, and the second for a Gigabit Passive Optical Network (GPON) configuration.

Figure 2: Ring Configuration Example

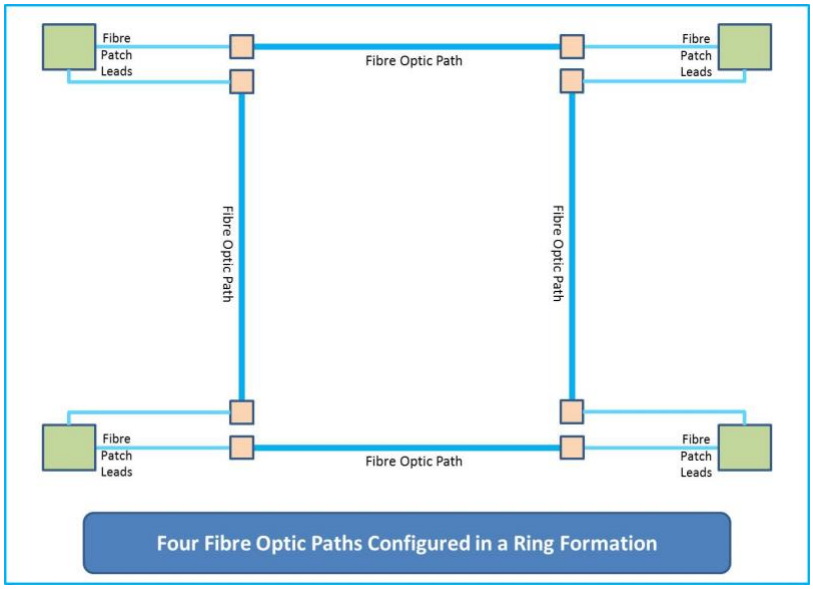
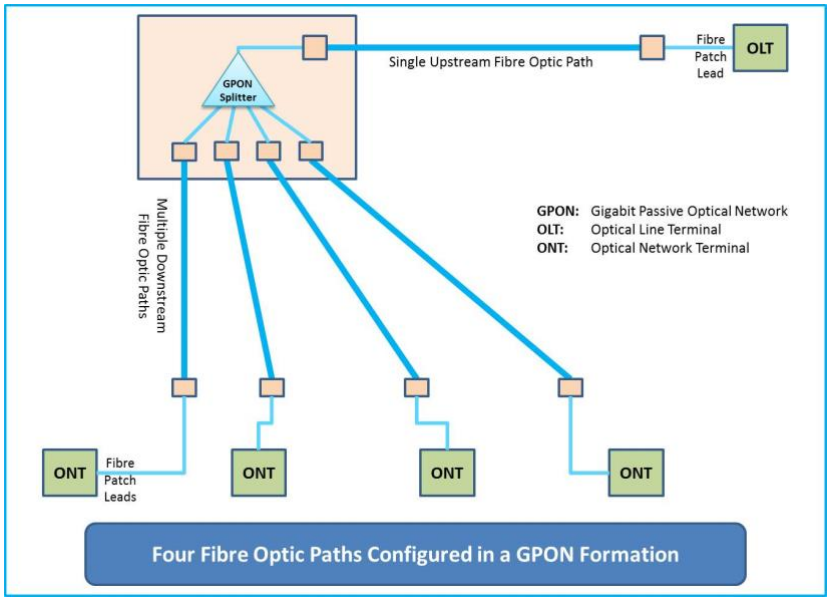
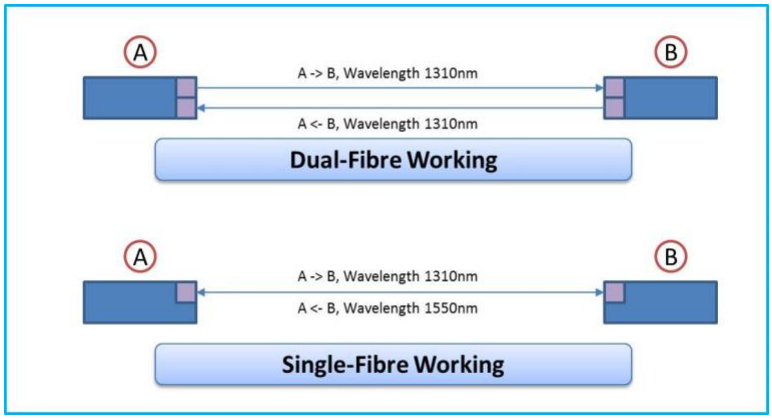


Figure 3: GPON Configuration Example



Technically, the fibre optic path can be provided as “single fibre working” or “dual fibre working”. With the former, a single strand of fibre is used to transmit data in both directions using different wavelengths, whereas with the latter one fibre strand is used for one direction and a second for the reverse direction. This is illustrated in the Figure 4 below.

Figure 4: Single and Dual Fibre Working



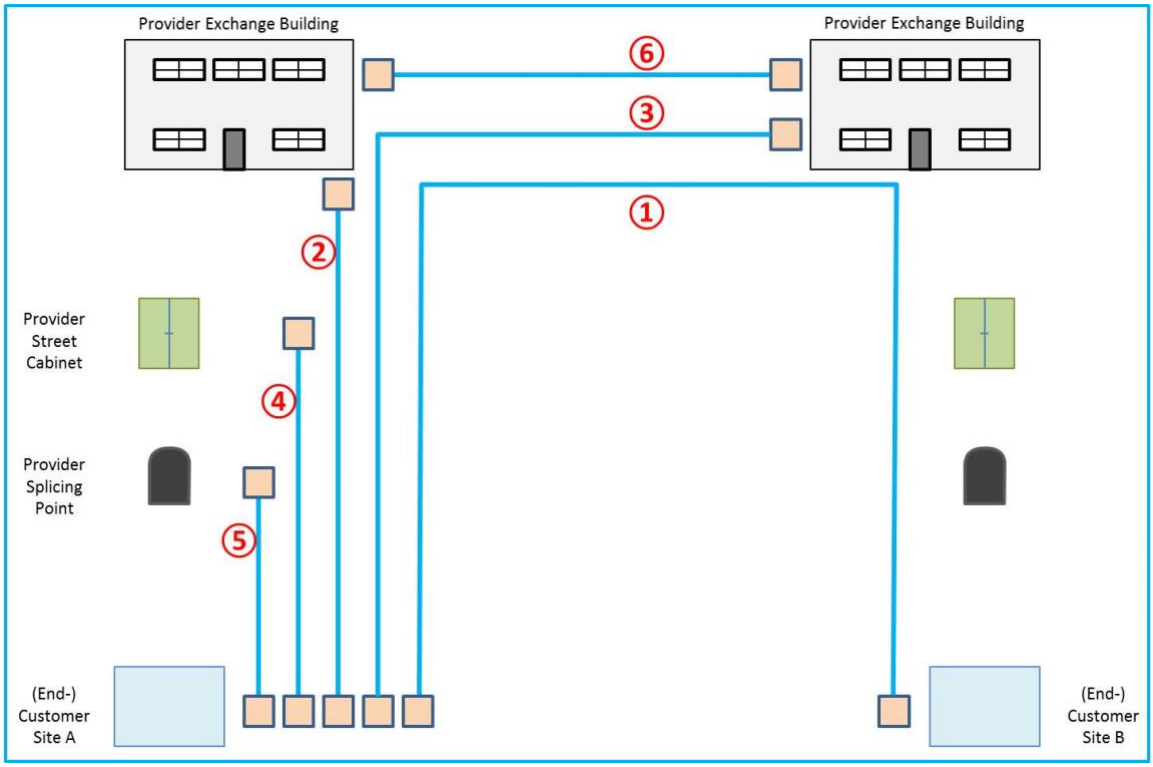
Single fibre working is a simple example of wave division multiplexing (WDM) in use, although in this case just two different wavelengths are used on the same strand of fibre.

Depending on the scope of the dark fibre access product, the fibre circuit could be deployed in a number of different configurations, including:

1. (End-) customer site A to (End-) customer site B
2. (End-) customer site A to interconnect point at local Provider Exchange Building
3. (End-) customer site A to interconnect point at remote Provider Exchange Building
4. (End-) customer site A to interconnect point at local Provider Street Cabinet
5. (End-) customer site A to interconnect point at local Provider Splicing Point
6. Interconnect point at Provider Exchange Building to interconnect point at second Provider Exchange Building

It is quite possible that the customer at each end of the circuit might be a different organisation/company. One example of this would be if the circuit was between an office and a shared data centre.

Figure 5: Possible Fibre Circuits



3.2 Availability: Local Network and Potential Interconnection Points

There are a number of different aspects to availability for a dark fibre access product:

- The existing coverage of fibre across the local access network. JT's fibre network is ubiquitous across the whole island and so dark fibre access should be available throughout Jersey.
- Whether there is any distinction between fibre deployed for residential-type services and that deployed for high quality business connectivity services.
- Location of the endpoints of the physical fibre optic cables, and the practicality and cost of enabling these locations to be used as interconnection points by access seekers.
- The extent to which there is spare capacity in existing cables (number of fibres present in a cable compared to number in use).
- The practicality, and cost, of pulling additional fibre cables along duct routes already carrying such cables.
- The practicality, and cost, of expanding coverage along routes where no existing fibre cables run.

In addition to the above, there is the scope of the dark fibre access remedy, which in conjunction with the above bullets could directly impact availability across Jersey. As a minimum, the Authority might decide to limit the scope of dark fibre access to existing fibre circuits already in use, either by the provider directly to the end customer or via an active wholesale leased line product. Where there was no existing circuit in use, then the Authority might allow an access seeker to first request an active circuit from the provider and then convert it to dark fibre access once the minimum contract term had expired. There would also be the issue of whether or not the presence of a fibre cable into the required building (whether or not it is in use) could be used as a proxy for "existing fibre circuit" in establishing technical availability. Imposing such a restriction in the remedy would severely limit the attractiveness of dark fibre access to access seekers.

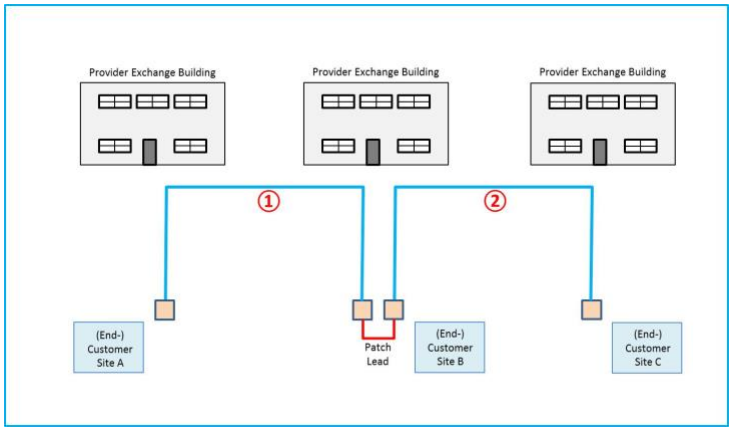
As a maximum, the Authority might decide that dark fibre access must be provided between any two points specified by the access seeker, but with the access seeker being liable to pay the provider for excess construction costs in deployment of the circuit where no existing fibre is present. Examples of such costs would be the installation of new duct and installing a new fibre cable in existing duct. In such cases, the dark fibre access remedy would almost certainly need to mandate the basis of how those excess costs were to be calculated, not least to avoid the risk that all the costs of provision are loaded on to the first customer.

In the dark fibre access Reference Offer, the provider would be expected to produce a list detailing which interconnection points exist and are available for use by access seekers.

3.3 Route Distance Limitations

Standard fibre transceiver modules can cope with distances of approx. 80km, so it is unlikely that there will be any practical distance limitations with dark fibre access circuits on Jersey, as long as active equipment is put on each end of a circuit. One theoretical exception to this would be if multiple dark fibre access circuits were "daisy chained" together passively through patch leads such that the aggregate distance exceeded the allowable limit, as illustrated below. The dark fibre access Reference Offer would therefore need to specify any applicable route distance limits.

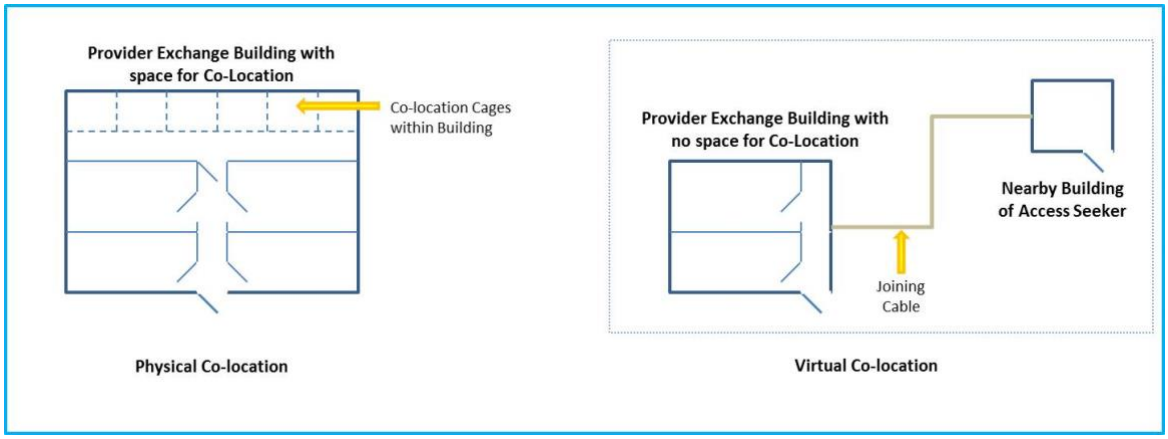
Figure 6: Fibre Daisy Chaining



3.4 Need for (Virtual) Co-Location and Associated Services such as (Back-Up) Power

Where one or both ends of the dark fibre access circuit is located within or at the circuit provider's site, there will be a need for co-location. In some situations, most likely in an exchange building with unused space, this will be practical to arrange. In other situations virtual co-location will be necessary, such as with Street Cabinets or Splicing Points (should these be within the scope of dark fibre access). The difference between physical and virtual co-location is illustrated below, taking the example of an exchange building which in one case has suitable space available within it and another case where it does not.

Figure 7: Co-location Options



For both physical and virtual co-location, there would be a need for a formal Reference Offer to be prepared by the provider and agreed with or approved by the Authority. For physical co-location, services covered by such a reference offer would typically include:

- Access to space within a building or cabinet. Such access would most likely need to be secure to some extent – for example, to prevent one access seeker gaining access to the space used by other access seekers.
- Access to power, potentially mains voltage and/or 48V DC.
- Access to air conditioning, particularly where the provider has this installed for their own purposes.
- Access to back-up power, particularly where the provider has this installed for their own purposes.
- Right to unaccompanied entry to a building. Whilst unaccompanied entry to a street cabinet is very unlikely to be viable, it is reasonable to expect to be allowed such entry to an exchange building if that building is not manned by the provider.

For virtual co-location, the access seeker would establish its own physical site close by and then a joining link cable would need to be run between those two sites. Depending on whether the provider or the access seeker ran this cable, the official service demarcation point could be located either at the location of the provider or the access seeker.

It is probably not reasonable for JT to arrange space at their own sites in advance of any co-location orders from access seekers. There would thus need to be some agreed and approved process that would trigger JT into undertaking the necessary preparatory work and how the costs of such work would be recovered.

Currently, there are no co-location requirements on Jersey so these would need to be developed if required.

3.5 Technical Specification of the Fibres in the Cable

The fibre used for dark fibre access would be single mode fibre, rather than multi-mode fibre, due to the distance limitations of the latter (hundreds of metres, compared to tens of kilometres for single mode). Within the broad category of "single mode", there are many different variants in use across the telecommunications sector. Each variant has its own particular characteristics: for example, the particular wavelengths of light with which it has been optimised to work or with how tight a bend radius it can cope. The dark fibre access Reference Offer will need to specify the precise variant (or variants) of fibre that are currently in use, and thus could be supplied in response to a request from an access seeker. One particular reason for this is that not all

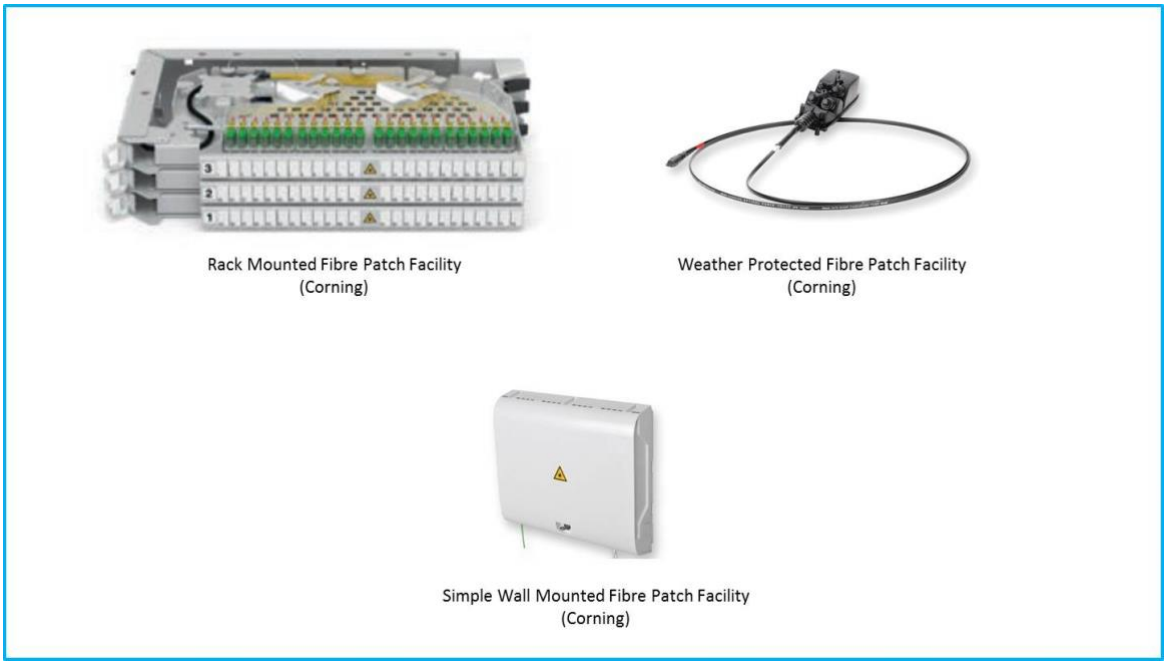
variants would be suitable for Coarse and/or Dense Wave Division Multiplexing (CWDM/DWDM), which might then limit its usefulness to the access seeker.

3.6 Fibre Connection Points (Service Demarcation Points)

Since no active equipment forms part of the dark fibre access product, the service demarcation point will be a fibre optic connector at each end of the fibre path (or two such connectors if the service provided is dual fibre working).

JT is expected to have a range of connection options already in use for its own fibre-fed business customers and may have standardised on a particular connector option that it uses for a number of specific cases. In some cases, the connection option will be a rack mounted patch panel and in others a wall mounted patch panel, or even a simple wall faceplate (see Figure 8**Error! Reference source not found.**). Where an existing active service is to be changed to dark fibre, then the existing connection option will tend to be retained. However, for new dark fibre access circuits, requiring new fibre to be installed, then the access seeker will need to be able to specify, from a set list published by the provider, which connection option they require.

Figure 8: Connection Equipment



Co-location space will be a service requirement for dark fibre access circuit ends within an existing exchange building and, in such cases, the provider will most likely deliver a rack mounted patch panel solution to the access seeker. The OLO may be expected to provide its own patch

panel with fibre leads to connect to the JT patch panel. The specifics on the connection would need to be explained in the Dark Fibre Reference Offer.

Should the scope of the dark fibre access product allow for connections to street cabinets and/or fibre splicing points (the latter generally being located in access chambers), then specialised, rugged connection solutions will most likely be needed. In such cases, the provider is perhaps most likely to specify a single option/type for use by the access seeker in the Reference Offer.

In all cases, the provider will need to specify in its Reference Offer, which connection and connector solutions are available for selection, by the access seeker in each situation.

3.7 Service Level Agreement and Service Level Guarantee

There will be a need for JT to prepare and publish one or more official/legal documents that stipulate the service level agreement (SLA) that would exist between the provider and the access seeker and a service level guarantee (SLG) available including the compensation to be provided should the guarantee not be met at any specific stage. Matters that would typically be included within such documents include:

- Service definition
- Service options
- Relevant technical specifications
- General service availability
- Service ordering and provision
- Service migration
- Service cancellation
- Technical quality of service
- Account and service management
- Fault reporting and complaint handling
- Provision and ongoing service levels provided
- Compensation for failure to meet contracted service levels

Preparation and maintenance of these formal documents would be the responsibility of the provider but could be subject to oversight by the Authority, especially if there are significant areas of disagreement between the provider and the access seeker over the contents. Although

JT would be expected to prepare a standard SLA and SLG, an access seeker might wish to be able to offer an enhanced SLA/SLG to its own customers. In such cases, the access seeker would be expected to use the formal Statement of Request process to request such enhancements.

4 INTERNATIONAL PRECEDENTS

Whilst some European and other countries have introduced dark fibre access in other markets (in particular the Wholesale Local Access market), Austria and the UK[4] are the only two European countries that have introduced a Dark Fibre Access remedy in the wholesale high-quality access provided at a fixed location market (Market 4)[5], which is equivalent to the business connectivity market[6]. This section briefly describes the history of dark fibre access in each country and the lessons learnt that may be applicable to Jersey.

There are two key lessons can be drawn from the experience of dark fibre access in Austria (see section 4.1) and the UK (see section 4.2):

- The RTR's experience shows that pricing is important. For dark fibre access to be attractive to OLOs dark fibre must be priced at a level that makes it economically viable for the access seeker, whilst not being set below the network operator's efficient costs of provision.
- The UK experience shows that it is important for NRAs to have a clear objective and to set a coherent policy. Ofcom revised its policy objectives and how dark fibre access should be used, which led to market confusion and a now limited scope of the remedy.

4.1 Austria[7]

The Austrian Regulatory Authority for Broadcasting and Telecommunications (RTR) first imposed dark fibre access as a remedy in Market 4 in its review of 2014[8] in the 1,775 (of a total of 2,130) communities where A1 Telekom Austria (A1) held Significant Market Power (SMP). No operator has SMP in 355 urban communities or the 43 inter-city trunk routes. The regulations only apply in communities where there is SMP.

[4] BEREC (2019) 'Access to physical infrastructure in the context of market analyses' June 2019. At the time of publication only Austria had introduced this remedy in market 4. Subsequently, the UK regulator, Ofcom, imposed dark fibre access on BT (Ofcom (2019) 'PIMR and BCMR Statement')

[5] European Commission (2014) 'COMMISSION RECOMMENDATION on relevant product and service markets within the electronic communications sector susceptible to ex ante regulation' 9 October 2014

[6] The limited number of dark fibre precedents results from seven equivalent EU markets being defined as fully competitive and eight being found as partially competitive (other than the UK and Austria).

[7] This section is based on an interview with a representative of the RTR and desk research.

[8] Available at https://www.rtr.at/de/tk/M_1_5_12

Much of the drive for dark fibre access came from Mobile Network Operators (MNOs) who wanted dark fibre backhaul connectivity to base stations. Austria has a high level of fixed-mobile substitution for broadband with many mobile broadband offers having similar data caps to fixed broadband offers. MNOs, therefore, have a need for increasing amounts of backhaul capacity.

However, MNOs also faced a problem as they were unable, due to competition from fixed network operators, to increase revenues from end users but could face increasing costs for additional backhaul capacity required to meet demand. The RTR, therefore, considered that dark fibre could allow MNOs to provide higher data allowances without increased costs. It should be noted that this objective could have been met by having cost-based access to active leased lines for mobile backhaul, if prices were not set on a cost-oriented basis.

At the same time, fixed Communications Providers (CPs) were demanding more flexibility so that they could offer differentiated services to commercial companies and government entities.

Dark fibre access was introduced as a remedy in 2014 and A1 was allowed 8 weeks from the date of the final Decision to develop a Reference Offer. Although A1 made some arguments against dark fibre in its response to the market review, it did not launch an appeal against the RTR's decision and so accepted the decision of the RTR.

However, by the time of the 2018 market review[9], no dark fibre circuits had been requested by MNOs or CPs in the regulated communities. The RTR was of the view that the regulated price of dark fibre access was too high to be economically viable. In the 355 unregulated communities, there is considerable demand for dark fibre access and the commercial price is substantially lower than the regulated price elsewhere.

In the 2018 market review, therefore, the RTR sought to lower the price of dark fibre access by, for example, making adjustments to asset lifetimes[10]. It also introduced "active minus" pricing with the dark fibre price set at the wholesale price for a 1Gbps Ethernet leased line less €428 as the calculated cost of the electronic equipment A1 does not need to provide.

[9] https://www.rtr.at/de/tk/M_1_8_15

[10] For example, the lifetime for fibre was extended from 30 years to 40 years.

The RTR reported that there has been some take up of dark fibre since the new remedy came into force, but demand appears to be quite low. It is possible that the price of dark fibre still remains too high for CPs to find it economically viable. The regulated cost-based price of dark fibre is €0.167 per metre per month in urban areas and €0.086 per metre per month in non-urban areas. This is reported to be more expensive than the price of dark fibre in unregulated areas by a factor of around four.

4.2 United Kingdom

Ofcom, the UK regulator, first proposed a dark fibre access remedy in the 2016 Business Connectivity Market Review (BCMR)[11] under which BT would have been required to provide access to dark fibre on terminating segments of Contemporary Interface[12] (CI) leased lines in two geographic markets: the London Periphery and the Rest of the UK (excluding the Hull area). However, the outcome of this market review was rejected by the Competition Appeals Tribunal (CAT) and Ofcom was required to withdraw the proposed regulations. It should be noted that the CAT's decision was not based on the dark fibre access remedy, but on Ofcom's failure to define the market correctly.

During the process of implementing dark fibre access in the business connectivity market, Ofcom conducted the Strategic Review of Digital Communications (known as the Digital Strategic Review or DSR), in which it switched emphasis from wholesale access to active services to competition in broadband markets based on competing networks using duct and pole access. At the same time, it was trying to limit the scope of dark fibre in the business connectivity market. This led to a somewhat confused outcome.

In 2017, Ofcom issued a consultation paper on dark fibre as a remedy in the business connectivity market[13] in which they proposed dark fibre access in lower bandwidth (<1 Gbps)

[11] Ofcom (2016) 'Business Connectivity Market Review – Statement' 28 April 2016. See Vol. I, Section 9
[12] Contemporary Interface is the term used by Ofcom and is their generic term for Ethernet.
[13] Ofcom (2017) 'Dark Fibre Consultation' 23rd November 2017

CISBO[14,15] markets. Ofcom proposed that BT should provide dark fibre terminating segments, including disaggregated access and backhaul segments and short-range end-to-end segments.

However, by the time of the 2019 Statement on the combined Physical Infrastructure and Business Connectivity Market Reviews[16] Ofcom restricted the dark fibre access remedy to inter-exchange circuits from BT only exchanges with no rival networks close by. Ofcom required that BT launch the product on 1st January 2020. Further, Ofcom placed more emphasis on inter-network competition based on access to existing physical infrastructure. Ofcom now sees dark fibre as a complement to duct and pole access where that is not effective. This is because its primary policy objective is to use competition to drive investment in fibre.

Openreach's "Dark Fibre X" product offers an unlit optical path between two qualifying BT exchanges no more than 86 route kilometres apart. It is available in two variants: single fibre or fibre pair. Communications Providers placing an order for Dark Fibre X must ensure that they have secured co-location access to space and power in the relevant BT exchange before placing an order.

Openreach charges for Dark Fibre X on a fixed annual rental plus a charge per metre (see Annex B).

When Ofcom originally proposed a dark fibre access remedy, it sought to impose a regulated price on an "Active Minus" basis based on the 1Gbps active product and limiting its use to speeds of no more than 1 Gbps, as it was only in the sub-1Gbps market where BT had SMP. In essence this would mean that the regulated price of dark fibre access would be the wholesale price of the corresponding 1Gbps active product, less the costs avoided by Openreach for providing the unlit circuit. There were a number of practical issues with this approach that meant it could not be sustained, in particular it would have been extremely hard to police the use of a dark fibre and whether it was being used for a circuit $\leq$1 Gbps.

[14] Contemporary Interface Symmetric Broadband Origination.
[15] Ofcom uses the term 'Symmetric Broadband Origination' for terminating segments running between a customer site and BT network node. 'Contemporary Interface' is used synonymously with Ethernet.
[16] Ofcom (2019) 'PIMR and BCMR Statement' Vol II, Section 12

Ofcom therefore changed its approach and set the regulated price for Dark Fibre X based on the cost of provision of dark fibre access "with reference to the relevant costs of BT's underlying passive infrastructure necessary for connections between exchanges"[17].

No information is available on the take up of Dark Fibre X at the time of writing this report.

In the Wholesale Fixed Telecoms Market Review[18] (WFTMR), Ofcom divides the UK into three geographic markets, Areas A, B and C, the last of which it considers to be non-competitive and without the prospect of competition at the network level. BT is considered to have SMP in this area and Ofcom proposes that BT be obliged to offer dark fibre access on cost-based terms for business connectivity services. Ofcom is still consulting on this market review and a final statement is not expected until later in 2020 or 2021.

[17] Ibid, para. 12.264

[18] Ofcom (2020) *'Promoting competition and investment in fibre networks: Wholesale Fixed Telecoms Market Review 2021-26'*

5 POTENTIAL DESIGN OF THE DARK FIBRE REMEDY

Should the Authority determine to go ahead with imposing a dark fibre access remedy on the SMP operator, this section sets out the process the Authority may pursue to implement the remedy (Section 5.1) and the broad parameters of the potential dark fibre access remedy on Jersey, summarised in the table below.

Table 1: Summary of potential remedy design

Parameters of the dark fibre access remedy	SPC Network comment	Further detail
Parity with active wholesale products	A dark fibre access only remedy would be in line with best practice and allow competition in downstream wholesale and retail markets. No customer group is likely to suffer significant harm from the removal of regulated wholesale access to active leased lines. Wholesale access should therefore be at dark fibre access level only.	Section 5.2
Migration to dark fibre access	Regulated access to active wholesale products should only be withdrawn once a fit-for-purpose dark fibre access remedy is in place and sufficient time has elapsed for migration. The time period required would be agreed at a later date.	5.3
Scope of dark fibre access	Dark fibre access could be implemented for end-to-end connections, tail circuits or interexchange circuits as seen fit. The preferred approach should be related to market demand and the costs of implementation. For examples, if OLOs require dark fibre tail circuits a co-location obligation would be needed and included in the dark fibre access Reference Offer.	5.4
Provision of new infrastructure	Where a dark fibre is requested to a location with no fibre at present, the dominant firm should be required to provide this fibre but be allowed to charge an excess construction charge over and above a fixed amount.	5.5
One or two fibre circuits	The regulated operator should be required to provide both one and two fibre circuits.	5.6
Provisioning, repair and migration	Provisioning of dark fibre should follow the same process as in place for wholesale active circuits. Fault detection and repair will be the primary responsibility of the OLO and should only passed to the dark fibre provider once the fault has been triaged.	5.7
Accommodation and co-location	As noted above, dependent on the scope of dark fibre access, JT may need to provide accommodation and co-location. SPC Network understands that no such obligation is currently imposed on JT and so this would have to be developed.	5.8

Pricing	The Austrian experience suggest that the price of dark fibre access is important both to promote demand and to ensure that JT can recover its efficiently incurred costs. It will therefore be important for the Authority to set out how it intends to set the price of dark fibre access to ensure these objectives are met.	5.9

5.1 Process for Implementing the dark fibre access Remedy

SPC Network suggests that the following three stages could be adopted to implement the dark fibre access remedy, should that be implemented following the current BCMR.

Stage 1: Further consultation process on key aspects for the dark fibre access remedy. This should include, but may not be limited to:

- the scope of the remedy;
- migration from current regulations to dark fibre access; and
- costing and pricing.

Stage 2: Following the completion of the consultation process above, JT should be required to produce a dark fibre access Reference Offer, SLA and SLG for consultation with the market and approval by the Authority. JT should also be required to propose a price, based on the cost modelling approach set out by the Authority, for approval by the Authority.

Stage 3: Launch of dark fibre access product by JT.

5.2 Parity with active wholesale products

The key question to address is whether the availability of regulated dark fibre access requires the continued availability of regulated wholesale active access: Should JT be required to continue to provide wholesale leased lines in addition to dark fibre access?

Best practice would suggest that regulation should be applied at one level only: the deepest practical level of the network (which in this case is dark fibre). A properly designed and implemented upstream remedy would then allow access downstream and effective competition to develop. Access at the lowest level of the network only also means regulation can be simplified and kept to the minimum necessary.

A market review is ultimately concerned with whether a market is working in the interests of end customers, in this case businesses and public sector bodies who use leased lines. It is, therefore, necessary to consider, whether any end customers could lose out if there were no regulated access to wholesale active leased lines[19]. There are two groups of end customers for whom this may be applicable: mobile network operators and businesses who buy from systems integrator/IT support companies. Although it would be expected that an effective dark fibre access remedy would lead to a commercial wholesale market, the implications of a lack of active wholesale leased lines on these two groups of customers are examined below.

- Mobile Network Operators (MNOs) use leased lines for backhaul from the base station to the core network. They currently use wholesale leased lines and so benefit from a price that is cheaper than the retail price. If they were unable to purchase wholesale leased lines and had to rely on retail lines, they would face a cost increase that may also affect their customers if they can pass on this cost increase.

  This a small risk as the three providers on Jersey (JT, Sure and Airtel) would be expected to have the necessary skills and resources to take advantage of dark fibre access.

- Systems integrators collate various IT and telecommunications equipment and services on behalf of clients who do not have the relevant expertise or resources to purchase direct from vendors. For some clients they may purchase leased lines for connection between offices or into a data centre.

  There are at least some systems integrators that hold telecommunications licences and so are able to purchase wholesale active leased lines at present. Where these companies have the requisite skills and resources to make use of dark fibre access they would probably use dark fibre instead of an active wholesale leased line. However, if they do not have the necessary skills and resources and there were no wholesale active leased lines available on either a regulated or commercial basis, they would need to purchase retail active leased lines.

[19] It is possible that wholesale supply would be available on a commercial basis with an effective dark fibre remedy. However, this cannot be guaranteed.

Customers of these systems integrator may suffer harm if prices of retail leased lines do not decrease and the systems integrator has to pass on the higher price of a retail line compared with a wholesale line to its customer. However, this harm would be reduced if, as expected, dark fibre leads to lower prices for retail leased lines.

The risk of harm to customers and systems integrators is therefore likely to be small.

To follow best practice, SPC Network recommends that once an effective dark fibre access remedy is in place, there should be no remedy at either the active or retail level. This is similar to the approach taken in the UK in the Wholesale Broadband Access (WBA) market, where regulation was withdrawn at the retail and then wholesale access levels once a fit-for-purpose local loop unbundling remedy was in place that facilitated entry at the wholesale level and BT had lost market share in individual exchange areas. The exact approach taken would need to be tailored to the development of the market in Jersey.

5.3 Migration to dark fibre access remedy

The move to a dark fibre access only remedy should not leave any wholesale customers unable to obtain access to the products they require to serve their customers. It is SPC Network's view that the current wholesale leased line access remedy should only be withdrawn once a fully fit-for-purpose dark fibre access remedy is in place. As the Austrian experience shows, a key element of the dark fibre access remedy is the regulated price, which needs to be a set at level that does not distort the market in favour of active access (by setting dark fibre prices too high) and which does not harm JT (by setting prices too low).

Additional protection could be added by ensuring that any active access contracts in place at the time regulated access to such products is withdrawn continue to be honoured over a period which is long enough to ensure effective migration.

5.4 Scope of dark fibre access

The scope of the dark fibre access remedy refers to the extent of the network in which dark fibre should be made available. The basic options are access tails only, inter-exchange or end-to-end (i.e. the whole circuit from the A to B end). The international precedents described above have a different approach: in Austria the scope is end-to-end, whilst in the UK it is inter-exchange circuits between "BT only" exchanges, i.e. where no other CP is located.

In some cases, an end-to-end dark fibre line may pass through a JT facility, such as an exchange or fibre node. In such a case, it is possible that the line will be connected to JT's active equipment at a location other than one of the ends. The precise details of how dark fibre is provided end-to-end in such circumstances will need to be worked out with the JT. However, in principle, JT would need to bypass any active equipment to provide a fully passive dark fibre.

SPC Network proposes that the Authority consult with the market to establish which option or options is likely to have the most market demand, given the costs associated with each option.

SPC Network recommends that there should be no constraint on the purposes for which the OLO uses the dark fibre. Thus, for example, it could be used to connect two customer sites, mobile base stations to a core network or two Points of Presence (POPs) of the OLO. This approach allows OLOs to gain access to wholesale products allowing them to offer a differentiated service.

5.5 Provision of new infrastructure

At present, there is no obligation on JT to provide a fibre connection to a business location, e.g. an end-customer premises, which is not already served by their network, even if the request for connection is reasonable. This would mean that if Sure, for example, acquired a new customer at a location not already connected to the JT network (such as a new office block or factory), JT would not have to provide the connection to those premises. This situation could prevent rival operators from competing for some customers.

The dark fibre remedy on Jersey would need to allow for new infrastructure being built, but it would be reasonable that not all the costs fell on JT if the cost of connection was beyond a reasonable limit.

SPC Network suggests that the Authority considers a similar approach to that used in the UK, whereby Openreach estimates the cost of connecting to a new location but is required to cover costs of up to £2,800. Any costs of connection above this threshold can be passed on to the access seeker in the form of an Excess Construction Charge (ECC). The amount of the ECC is notified to the access seeker prior to any construction work being undertaken by Openreach and the access seeker has the right to cancel the order at no cost if the ECC is too expensive. An effective dispute resolution procedure would be required if the requesting operator thought that the ECC was deliberately excessive.

Whilst Openreach has to cover costs of £2,800 itself, this should not be taken as meaning that is the correct amount for JT. The amount of the construction cost that should be met by JT would need to be determined.

5.6 One or two fibre circuits

SPC Network's view is that OLOs should have access to the same configurations as JT's own retail business would and so JT should be required to provide both one and two fibre circuits.

5.7 Provisioning, repair and service migration

The provisioning process in the remedy should be no different from that already in place for SDH and Ethernet leased lines. The main difference is that JT would not provide active equipment and would undertake a precision test to measure circuit performance parameters[20].

The fault repair process will be different as the OLO will be operating the equipment to conduct the initial fault monitoring and fault diagnostics. Faults would only be passed to JT once the OLO had established that the fault lies in the fibre rather than the active equipment. To prevent spurious or unfounded "faults" being passed to JT, it should be allowed to levy a reasonable "Right When Tested" charge if a fault passed to it by the OLO is found not to be on the JT fibre.

5.8 Accommodation and Co-Location

Dependent on the type of circuits required by the market, there may be a need for co-location of OLO equipment in JT provided accommodation. However, SPC Network understands that there is no co-location obligation on JT at the moment and so it may be necessary for co-location terms to be established and included in the Reference Offer.

[20] A similar test to the one envisaged here is described in the Openreach Fibre X Reference Offer (Section 4.3)
"At post order closure and when we hand the circuit over to you, we will have performed a full insertion loss and Optical Time Domain Reflectometer ("OTDR") test and provided an OTDR "birth certificate" which will display the actual performance characteristics of the DFX service. This will be available for you to download after KCI3 via an appropriate dialogue service following order completion.
If further baseline tests are carried out during the lifetime of the circuit triggered by any service changes, the baseline test records will be updated and available for you to download. You will always be able to see the most up to date set of baseline test results as well as the original baseline test birth certificate result. The ODTR Baseline and service test data can be accessed via the Openreach Portal.

5.9 Pricing of dark fibre

The case study of Austria shows how important it is to set the price of dark fibre at the right level to support demand. At the same time, SPC Network recognises that JT has made a substantial investment in rolling out its full fibre network and that the regulated price must not hinder it making a proper return in its investment.

SPC Network proposes that the Authority should consult with stakeholders on the most appropriate pricing mechanism. However, drawing on the UK experience, SPC Network does not recommend that the Authority proposes an “active minus” approach for the simple reason that dark fibre does not correlate with an active product. The authority should note that Ofcom changed from an active minus pricing approach due to various practical problems, as noted earlier.

SPC Network suggests that the Authority should adopt a cost-based approach to the development of a dark fibre price with reference to the relevant costs of JT’s passive infrastructure necessary for connections that fall within the scope of the remedy as finally decided by the Authority (end-to-end, inter-exchange and/or tail circuits). On the assumption that no further networks would be built on Jersey, in line with government policy, it would not be appropriate to calculate these costs on a forward-looking basis.

Annex A: Glossary of terms

Access Seeker	A communications operator that purchases access to network from an infrastructure operator.
Backhaul	A fibre line that connects an access point, such as a mobile base station with the core network of the operator.
Bandwidth	An alternative word for speed
Communications Provider	A generic term for telecommunications operator,
Dark Fibre	A dedicated fibre optic path where the circuit provider has no active electronics attached at either end. The access seeker is able to attach their own active equipment directly to the ends of the fibre path and "light" it at whatever speed they choose and in whatever configuration they choose, within the limitations of what is technically feasible for that particular fibre.
Fibre node	The main locations in the operator's network where fibre cables converge and operator's equipment is also located.
Fixed telecommunications	Communications provided by firms at a fixed location.
Incumbent	An existing operator that is normally the former monopoly.
Infrastructure	Physical infrastructure used for a communications network, such as ducts, cables and associated facilities
Infrastructure competition	Competition between firms using their own infrastructure to provide services to customers
Multiplexor	A device which combines multiple analogue or digital signals into one signal over a shared medium.
Network levels/layers	
Other Licensed Operator (OLO)	A licensed operator other than the incumbent operator
Router	A networking device that forwards data packets between computer networks.

Service competition	Competition between firms based on access to the infrastructure of another firm on either regulated or unregulated contract terms.
Speed	The rate at which data are transferred across a network measured in Megabits or Gigabits per second
Wave Division Multiplexing	A technology that brings together a number of different optical carrier signals onto a single optical fibre by using a different wavelength for each carrier.

Annex B: Openreach Fibre X Prices

Connection Prices

Feature	Operative Date	Connection £ (Ex VAT)
DFX Single Fibre	08/08/2019	375.00
DFX Fibre Pair	08/08/2019	638.00

Rental Prices

Feature	Operative Date	Annual Rental £ (Ex VAT)
DFX Single Fibre	08/08/2019	106.00
DFX Fibre Pair	08/08/2019	212.00

Main Link Charge

Feature	Operative Date	Annual Rental £ (Ex VAT)
DFX Single Fibre – per metre or part thereof	08/08/2019	0.125
DFX Fibre Pair– per metre or part thereof	08/08/2019	0.250

Prices valid at 12 October 2020