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Suppliers' Information Note

For The BT Network

Optical Spectrum Access™
Service & Interface Description

This SIN is available in Portable Document Format (pdf) from: http://www.btplc.com/sinet/

Enquiries relating to this document should be directed to: sinet.helpdesk@bt.com

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1. Introduction

This Suppliers' Information Note (SIN) describes the Openreach Optical Spectrum Access (OSA) service, and its interfaces. Optical Spectrum Access (OSA) is an Openreach product within the Optical Spectrum Services portfolio.

The OSA service will be updated with additional new equipment (ADVA FSP3000 replacing ADVA FSP2000, which will continue to be supported) from 31stJanuary 2012.

2. Service Outline for FSP3000 based OSA services

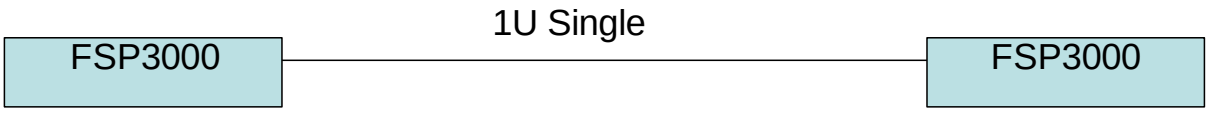
Maximum number of wavelengths supported by the Openreach OSA service and available for use is 32. This drops to 31 in the case of Resilience Option 1 protected bearers, (Optical Multiplex Section Protection), as this requires the Channel 32 for the Optical supervisory channel. Currently only a point-to-point service is supported on Openreach OSA.

Depending on the distance requirement and the transponder card types deployed, bearer may be deployed without amplification for short reach distances, preamplifier cards for intermediate reach distances and preamplifier and booster amplifier cards for the longest distances.

Bearer types offered on Optical Spectrum Access

Customers will be allowed to order bearers the following OSA bearer type options:

a. 1U Single bearer



For this configuration, the term “single” is used to indicate that 1U high FSP3000 shelves are deployed without DWDM filters and will only support a single channel.

Customers can choose either an AC or DC powered 1U chassis for each end of a link.

Card and channel growth

Channel growth beyond a single wavelength will require the 1U single bearer type to be converted to a 1U standard type via a modify order to support up to 4 wavelengths. Similarly, channel growth beyond 4 wavelengths will require conversion to a 7U standard bearer via a modify order. Please note any upgrades from 1U single to 1U Standard or 7U Standard or resilience service will be service effecting upgrade.

1U single bearer deployments will be limited to fibre route distances that will allow upgrade to 1U standard supporting growth to 4 wavelengths and 7U standard bearers supporting growth to 31/32 wavelengths. Any changes in the bearer type including the addition of an 8GSM filter to a bearer will be expected to require downtime.

Protection Options

RO1 protection will not be supported on this bearer option, though RO2 is supported via an RO2 variant of the 1U single bearer (OSA 1U RO2 No Filter). RO1 resilience will require an upgrade to the 7U RO1 bearer option, though confirmation that it will be possible to upgrade to RO1, will be subject to survey based on planning rules based on the bearer fibre route distance and transponder card types used on the bearer.

b. 1U standard bearer

A single 4-channel filter (4CSM) is fitted as standard to this bearer, therefore this service will support (non-traffic affecting) channel growth to 4 wavelengths.

Customers can choose either an AC or DC powered 1U or 7U chassis (7U chassis only valid for subsequent chassis) for each end of a bearer link. However the AC/DC option used for Chassis at end of a bearer, must be consistent. The mixing of AC and DC chassis at the A- end of a bearer (for example) is not permitted.

Card and channel growth

Channel growth beyond 4 wavelengths will require the 1U standard bearer to be upgraded to a 7U standard bearer via a modify order for the bearer as well as customer to order the 8GSM filter card. This bearer upgrade is traffic affecting, therefore any customer expecting growth beyond 4 wavelengths is encouraged to choose the 7U bearer option with 8 band filter card fitted to allow non-traffic affecting growth.

1U standard deployments are limited to fibre route distances that will allow upgrade to 7U standard bearers supporting growth to 31/32 wavelengths. However it will be permissible to add booster amplifier and preamplifier cards during the necessary downtime to compensate for the additional optical loss introduced by the 8 band filter card when growing beyond 4 wavelengths or optical loss introduced by the protection module if converting to 7U RO1 bearer.

If a 7U chassis is ordered as a 'subsequent' chassis, this bearer type will still be classed as a 1U standard bearer, with growth limit of 4 wavelengths. Growth beyond 4 wavelengths will require a Modify order to convert the "1U standard" bearer to a 7U standard bearer, with additional order to add the 8 band filter card and any additional amplifier cards. Upgrade to 7U standard bearer will in most cases, be carried out using a Provide and Cease of the chassis with 1U high chassis expected to be recovered. This upgrade will require

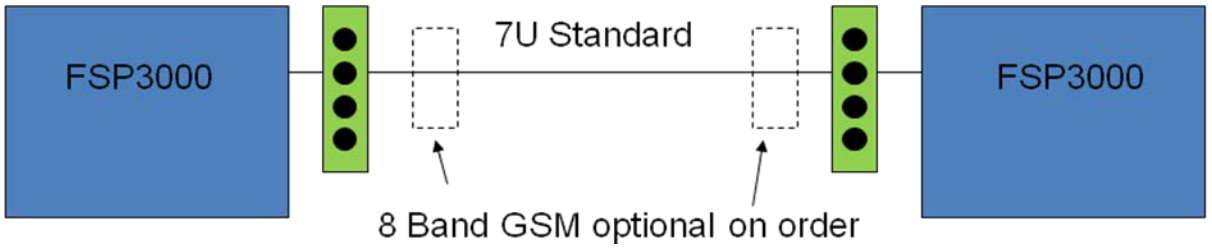
downtime but will allow RO1 capability (subject to distance limits not being exceeded) and will minimize space requirements for bearers containing a moderate number of wavelengths.

Protection Options

RO1 will not be offered on 1U standard bearers, even if the 1U standard bearer type contains a (subsequent) 7U high chassis, though RO2 resilience is supported as a 1U RO2 bearer option.

RO1 resilience will require an upgrade to the 7U RO1 bearer option. Whilst all bearers will be able to upgrade to support 31/32 wavelengths, confirmation that it will be possible to upgrade to RO1 will be subject to survey using planning rules based on fibre route distance and transponder card types used on the bearer.

c. 7U standard or 7U RO1 bearer



At order stage, customers may opt to have the 8 band filter module pre-deployed for 7U standard, 7U RO2 and 7U R01 bearer options. These OSA bearers may or may not be pre-deployed with 8 band filter modules. Where the 8GSM filter card is not pre-deployed, only a maximum number of 4 channels can be supported, any capacity increase beyond 4 wavelengths will require downtime in order to fit an 8 band filter module. Where the 8 band filter module is fitted, channel growth to 32 wavelengths can be supported without the need for downtime. Only 31 channels are supported in case of RO1 bearers.

Customers can choose either an AC or DC powered 7U chassis for each end of a bearer link. However the AC/DC option used for Chassis at end of a bearer must be consistent. The mixing of AC and DC chassis at the A-end of a bearer (for example) is not permitted.

Card and channel growth

Channel growth beyond 4 wavelengths will require the 7U standard bearer to contain an 8 band filter card. This bearer upgrade is traffic affecting, and in some cases will require additional amplifier cards to be added to compensate for additional loss introduced by the 8 band filter card particularly on longer links. Any customer expecting growth beyond 4 wavelengths should be encouraged to choose the 7U bearer option with 8GSM card fitted on initial order.

7U standard bearers may only be deployed over fibre route distances that will allow upgrade to 31/32 wavelengths. However it will be permissible to add post and pre-amplifier cards during the necessary downtime to compensate for the additional optical loss introduced by the 8 band filter card when growing beyond 4 wavelengths or optical loss introduced by the VSM protection module if converting to 7U RO1 bearer.

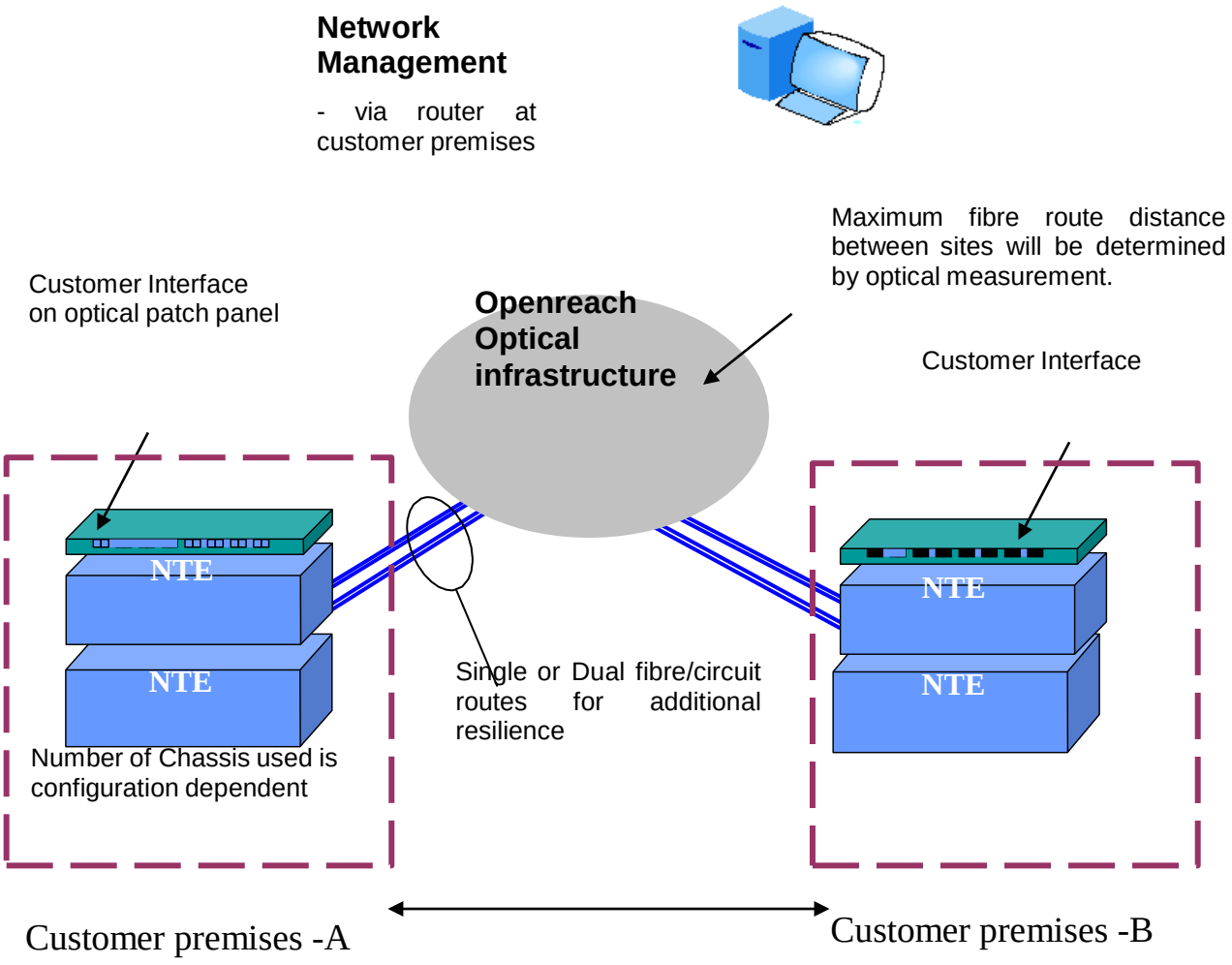
Protection Options

The 7U standard bearer is the only OSA bearer option that has a variant that supports RO1 protection (7U RO1), however the upgrade from 7U standard bearer to 7U RO1 bearer will be traffic affecting and as a result require downtime. Confirmation that it will be possible to upgrade a 7U standard bearer to 7U RO1 bearer, will be subject to survey using planning rules based on fibre route distance and transponder card types used on the bearer.

As with the other bearer options, an RO2 variant can be ordered (7U RO2 bearer) by the customer.

Downgrade of bearers types are not supported as part of the OSA service, this will not affect the ability to raise cease orders for wavelengths that are no longer required.

A typical FSP2000/FSP3000 OSA service configuration is shown below in Figure 1.



Maximum Radial distance between BT serving exchanges is 35km for FSP2000, There is no Maximum distance on FSP 3000 but both are dependent on fibre route distance and card/filter configuration.

Figure 1 Typical FSP2000/FSP3000 OSA service configuration

3. General Service Outline for FSP2000 based OSA services

SPECIAL NOTICE
Openreach has formally notified the withdrawal from new supply of all FSP2000 products as from 1st April 2013. Including all Resilience Options (RO1 & RO2) associated with the above products. Existing installed products will continue to be supported until otherwise advised, this includes in life resilience options along with Product bandwidth upgrades/ regrades, shifts and re-arranges.

Please refer to Openreach briefing ETH56/12 (www.openreach.co.uk)

Optical Spectrum Access is an end-to-end wavelength service between two sites delivered over Openreach provided fibre infrastructure using DWDM (Dense Wavelength Division Multiplexing). Optical Spectrum Access is suitable for linking end user sites, or an end user site to a Communications Provider's (CP) site, or between a Licensed Facility and a CP site.

High bandwidth connectivity of up to 10Gbit/s per DWDM wavelength is offered. Currently, up to 32 x 2.5Gbit/s wavelengths or 16 x 10Gbit/s wavelengths can be supported on each OSA bearer system. An Optical Spectrum Access Bearer that has active 10Gbit/s wavelengths and/or amplification installed is limited to a maximum of 16 wavelengths.

The OSA product structure is modular. The elements of the service are:

- **OSA Bearer**: this is the DWDM line system which can support a mix of 2.5Gbit/s or 10Gbit/s wavelengths. The default installation is configured to support up to eight 2.5Gbit/s or 10Gbit/s wavelengths (wavelengths are ordered separately).
- **Expansion modules**: these modules provide capacity for additional wavelengths on the OSA Bearer. There are two expansion modules available to support wavelengths 9-16 and wavelengths 17–32 (wavelengths are ordered separately). Wavelengths 17-32 are fitted in a separate chassis.
- **End point amplification**: Over longer fibre route distances additional end point amplification may be required to ensure the OSA Bearer system works effectively. OSA Bearers with amplified fibre routes are limited to a maximum of 16 wavelengths irrespective of the wavelengths (2.5Gbit/s or 10Gbit/s).
- **Wavelengths**: these are ordered separately from the bearer and are specific to the protocol and speeds required. An individual wavelength can be supplied with multiple service interfaces. They are installed in the OSA Bearer chassis.

The OSA service is limited to a maximum of 35km radial distance between BT serving exchanges. The maximum amplified fibre route distance between OSA Bearer circuit end points is typically 70km determined by the NTE type and resilience configuration as shown in the OSA product handbook. End-point amplification is added to the NTE only when required to ensure the OSA bearer system works effectively. Mid-point amplification is not provided on the OSA service.

Note that in some configurations, double width cards and end-point amplification will limit the maximum number of wavelengths and service interfaces that can be installed in an OSA Bearer chassis.

3.1 NTE vendor

The Network Terminating Equipment (NTE) types currently used for Optical Spectrum Access service, are the ADVA FSP2000 and ADVA FSP3000.

ADVA offers a choice of service interface cards. Please refer to the Optical Spectrum Access product handbook for further information

http://www.openreach.co.uk/orpg/home/products/opticalservices/opticalservices.do

3.2 Services supported on the FSP2000

The service allows the point to point transport of the following services between customer sites: -

- STM-64 (9.9532 Gbit/s)
- STM-16 (2.488 Gbit/s)
- STM-4 (622 Mbit/s)
- STM-1 (155 Mbit/s)
- Gigabit Ethernet (1.25 Gbit/s)
- 10Gb Ethernet LAN PHY (10.3125 Gbit/s)
- 10Gb Ethernet WAN PHY (9.9532 Gbit/s)
- FICON (1.062 Gbit/s)
- FICON Express (2.125 Gbit/s)
- Fibre Channel 1Gb FC100 (1.062 Gbit/s)
- Fibre Channel 2Gb FC200 (2.125 Gbit/s)
- Fast Ethernet (125 Mbit/s clock rate, 100 Mbit/s data rate)
- ESCON (200 Mbit/s)
- Coupling Link (ISC1 -1.062 Gbit/s) (ISC2 -1.062 Gbit/s) (ISC3 compatibility mode 1.062 Gbit/s & peer mode 2.125 Gbit/s)
- Sysplex Timer ETR & CLO (8 Mbit/s)

Optical Spectrum Access services are intended for connection to standard optical interfaces of 850 nm multimode or 1310 nm single-mode/multimode types. No electrical interfaces are offered. Table 1 gives details of the optical interface/service options for FSP2000.

3.3 Services supported on the FSP3000

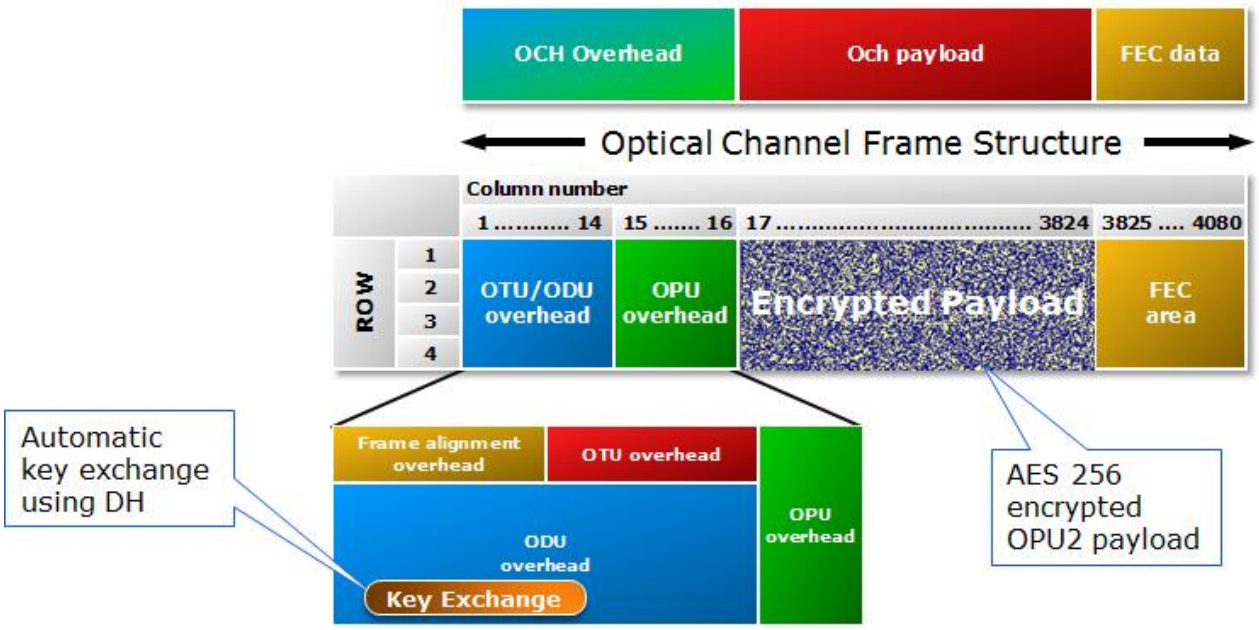
The service allows the point to point transport of the following services between customer sites: -

- STM-64 (9.9532 Gbit/s)
- STM-16 (2.488 Gbit/s)
- STM-4 (622 Mbit/s)
- STM-1 (155 Mbit/s)
- Gigabit Ethernet (1.25 Gbit/s)
- 10Gbit/s Ethernet LAN PHY (10.3125 Gbit/s)
- 10Gbit/s Ethernet WAN PHY (9.9532 Gbit/s)
- Fibre Channel/FICON 1Gbit/s FC100 (1.062 Gbit/s)
- Fibre Channel/FICON 2Gbit/s FC200 (2.125 Gbit/s)
- Fibre Channel/FICON 4Gbit/s FC400 (4.25Gbit/s)
- Fibre Channel/FICON 8Gbit/s FC800 (8.50Gbit/s)
- Fibre Channel/FICON 10Gbit/s FC1200 (10.52Gbit/s)
- Fast Ethernet (125 Mbit/s clock rate, 100 Mbit/s data rate)
- G.709 OTU2 (10.709 Gbit/s)
- G.709 OTU1 (2.666 Gbit/s)
- ISC-3 Peer Mode (2.125Gbit/s)

Optical Spectrum Access services are intended for connection to standard optical interfaces of 850nm multimode or 1310nm single-mode/multimode types. No electrical interfaces are offered. Table 2 gives details of the optical interface/service options for FSP3000.

OSA FSP 3000 Encryption Service

The OSA FSP 3000 encryption service delivers ultra-low latency wire-speed encryption from 1G up to 10G LAN PHY for new and existing OSA circuits. The service is built on ADVA Optical Networking's 5TCE-PCTN-10G-AES card delivering a range of protocols including Ethernet, Fibre Channel and ISC-3 all at Layer-1.



The 5TCE-PCTN-10G-AES card is built around symmetric-key encryption standard Advanced Encryption Standard AES256 announced by the National Institute of Standards and Technology (NIST). The encryption solution utilises Diffie Hellman key exchange and a dedicated Openreach security NOC team.

3.4 Circuit protection (information valid both for FSP3000 and FSP2000)

This service is offered on a point-to-point basis with optionally no fibre circuit protection (Standard), or with Resilience Option 1 or Resilience Option 2 protection options.

- **Standard** consists of a single OSA Bearer between the circuit A-end and B-end addresses with no standby circuit or path. In the event of a fibre failure service may be lost. It is recommended that a back-up service is available.
- **Resilience Option 1 (RO1)** consists of a single OSA Bearer between the same circuit A-end and B-end addresses with two diversely routed fibre paths. In the event of a problem occurring on the primary route, traffic will be automatically switched to the secondary fibre path. The protection is performed on the fibre link carrying the multiplexed wavelengths. Protection is not provided on a per optical channel basis.

- **Resilience Option 2 (RO2)** consists of two individual OSA Bearers delivered using diversely routed fibres between the same circuit A-end and B-end addresses, or between the same A-end and different B-end addresses. Customers are free to use each bearer as they wish. It is the customers' responsibility to ensure that the traffic carrying capacity of the wavelengths is sufficient to support the resilience of their service in the event of failure. Note that the two OSA bearers in an RO2 configuration do not perform an automatic protection switching. If protection switching is required this will need to be supplied by the CP.

The maximum permitted fibre route distance will vary depending on the vendor, wavelength speed and resilience option used. Refer to the OSA Product Handbook for further information on bearer resilience options and distance limitations:

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http://www.openreach.co.uk/orpg/home/products/opticalservices/opticalservices.do

Protocols with latency sensitivities may require customer reconfiguration following an incident resulting in a switch to the protection path. The Openreach equipment will continue to function on the protection path.

4. Customer Interface – FSP2000 only

4.1 General

Customer interfaces that will be offered are presented via an optical patch panel using Dual SC interfaces. Either a single duplex or a pair of simplex SC connectors may be used.

Single-mode (1310nm) or multimode (1310nm or 850nm) interface options are available depending on the type of wavelength card selected. Each NTE vendor offers a choice of wavelength interface cards, however there may be differences in the number and types of interfaces supported per card. Wavelength cards are vendor specific.

Service	Bandwidth	Customer Interface Options		
		Single-mode @1310 nm	Multimode @1310 nm	Multimode @850 nm
STM-64	9.9532 Gbit/s	Yes	No	No
STM-16	2.488 Gbit/s	Yes	No	No
STM-4	622 Mbit/s	Yes	Yes	No
STM-1	155 Mbit/s	Yes	Yes	No
Gigabit Ethernet	1.25 Gbit/s	Yes	No	Yes
10Gb Ethernet LAN PHY	10.3125 Gbit/s	Yes	No	No
10Gb Ethernet WAN PHY	9.9532 Gbit/s	Yes	No	No
FICON	1.062 Gbit/s	Yes	No	Yes
FICON Express	2.125 Gbit/s	Yes	No	Yes
1G Fibre Channel	1.062 Gbit/s	Yes	No	Yes
2G Fibre Channel	2.125 Gbit/s	Yes	No	Yes
Fast Ethernet	125 Mbit/s	Yes	Yes	No
ESCON	200 Mbit/s	No	Yes	No
Coupling Link ISC1 and ISC2	1.062 Gbit/s	Yes	No	No
Coupling Link ISC2		Yes	No	No
Coupling Link ISC3 Compatibility Mode	1.062 Gbit/s	Yes	No	No
Coupling Link ISC3 Peer Mode	2.125 Gbit/s	Yes	No	No
Sysplex Timer ETR/CLO	8 Mbit/s 16 Mbit/s	No	Yes	No

Table 1. FSP2000 Customer Interface options

Connector

The patch panel interface is the Network Termination Point (NTP), ie the point of connection between the Openreach Network Terminating Equipment (NTE) and the CPE interface. All optical interfaces are presented as dual SC connectors. Either a single duplex or a pair of simplex SC connectors may be used.

5. Customer Interface – FSP3000 only

5.1 General

The patch panel interface, where used is the Network Termination Point (NTP), ie the point of connection between the Openreach Network Terminating Equipment (NTE) and the CPE interface.

Customer interfaces that will be offered are presented via an optical patch panel or directly on the NTE using Dual LC interfaces. Either a single duplex or a pair of simplex LC cables may be used, though duplex cables with dual LC connectors will ensure that transmit and receive connections are correctly made the right way round.

Single-mode (1310nm) or multimode (850nm) interface options are available depending on the type of wavelength card selected. The NTE vendor offers a choice of wavelength interface cards, however there may be differences in the number and types of interfaces supported per card.

Please Note: The 10TCC-PCTN-4GUS+10G card is no longer available for new supply.

Service	**Card type**	**Transparency**	**Client Port Options** Pluggable type / maximum speed / wavelength /Single-Mode(SM) or Multimode (MM) / connector type	**Client port Error signal**
10G Fibre Channel	5TCE-PCTN-10GU+10G	PCS layer	SFP+/10G/1310S/SM/LC or SFP+/11GU/850I/MM/LC	Loss of Signal
	2WCA-PCN-10G	Physical layer	XFP/11G/1310S/SM/LC or XFP/10G/850I/MM/LC	Loss of Signal
	5TCE-PCTN-10GU+AES10G	PCS layer	SFP+/11GU/1310S/SM/LC or SFP+/11GU/850I/MM/LC	Loss of Signal
10G LAN PHY	WCC-PCTN-10G	PCS Layer	XFP/11G/1310S/SM/LC	Local Fault as per IEEE802.3
	2WCC-PCN-10G	PCS Layer	XFP/11G/1310S/SM/LC	Local Fault as per IEEE802.3
	5TCE-PCTN-10GU+10G	PCS layer	SFP+/10G/1310S/SM/LC or SFP+/11GU/850I/MM/LC	Loss of Signal
	2WCA-PCN-10G	Physical layer	XFP/11G/1310S/SM/LC or XFP/10G/850I/MM/LC	Loss of Signal
	5WCA-PCN-16GU	Physical layer	SFP+/11GU/1310S/SM/LC or SFP+/11GU/850I/MM/LC	Loss of Signal
	5TCE-PCTN-10GU+AES10G	PCS layer	SFP+/11GU/1310S/SM/LC or SFP+/11GU/850I/MM/LC	Loss of Signal
10G WAN PHY	WCC-PCTN-10G	client signal not modified	XFP/11G/1310S/SM/LC	MS-AIS (ITU-T G.783)
	2WCC-PCN-10G	client signal not modified	XFP/11G/1310S/SM/LC	MS-AIS (ITU-T G.783)

	2WCA-PCN-10G	Physical Layer	XFP/11G/1310S/SM/LC	Loss of Signal
OTU2	WCC-PCTN-10G	client signal not modified	XFP/11G/1310S/SM/LC	AIS-ODU
	2WCC-PCN-10G	client signal not modified	XFP/11G/1310S/SM/LC	AIS-ODU

	2WCA-PCN-10G	Physical layer	XFP/11G/1310S/SM/LC	Loss of Signal
8G Fibre Channel	5TCE-PCTN-10GU+10G	PCS Layer	SFP+/10G/1310S/SM/LC or SFP+/11GU/850I/MM/LC	Loss of Signal
	2WCC-PCN-10G	PCS layer	XFP/8G/1310S/SM/LC	Non-valid line code as per ITU-T G.7041
	2WCA-PCN-10G	Physical layer	XFP/8G/1310S/SM/LC	Loss of Signal
	5WCA-PCN-16GU	Physical layer	SFP+/11GU/1310S/SM/LC or SFP+/11GU/850I/MM/LC	Loss of Signal
	5TCE-PCTN-10GU+AES10G	PCS layer	SFP+/11GU/1310S/SM/LC or SFP+/11GU/850I/MM/LC	Loss of Signal
4G Fibre Channel	4TCA-PCN-4GU+4G	PCS layer	SFP/4GU/850I/MM/LC or SFP/4GU/1310S/SM/LC	Loss of Signal
	5TCE-PCTN-10GU+10G	PCS Layer	SFP/4GU/850I/MM/LC or SFP/4GU/1310S/SM/LC	Loss of Signal
	10TCC-PCTN-4GUS+10G	PCS layer	SFP/4GU/850I/MM/LC or SFP/4GU/1310S/SM/LC	Non-valid line code as per ITU-T G.7041
	2WCA-PCN-10G	Physical layer	XFP/8G/1310S/SM/LC	Loss of Signal
	5TCE-PCTN-10GU+AES10G	PCS Layer	SFP/4GU/850I/MM/LC or SFP/4GU/1310S/SM/LC	Loss of Signal
2G Fibre Channel	4TCA-PCN-4GU+4G	PCS layer	SFP/2G1/850I/MM/LC or SFP/2G5U/1310S/SM/LC	Non-valid line code as per ITU-T G.7041
	5TCE-PCTN-10GU+10G	PCS layer	SFP/2G1/850I/MM/LC or SFP/2G5U/1310S/SM/LC	Loss of Signal
	10TCC-PCTN-4GUS+10G	PCS layer	SFP/2G1/850I/MM/LC or SFP/2G5U/1310S/SM/LC	Non-valid line code as per ITU-T G.7041
	2TWCC-PCN-2G7U	Physical layer	SFP/2G1/850I/MM/LC or SFP/2G5U/1310S/SM/LC	Loss of Signal
	5TCE-PCTN-10GU+AES10G	PCS layer	SFP/2G1/850I/MM/LC or SFP/2G5U/1310S/SM/LC	Loss of Signal

1G Fibre Channel	4TCA-PCN-4GU+4G	PCS layer	SFP/2G1/850I/MM/LC or SFP/2G5U/1310S/SM/LC	Non-valid line code as per ITU-T G.7041
	5TCE-PCTN-10GU+10G	PCS Layer	SFP/2G1/850I/MM/LC or SFP/2G5U/1310S/SM/LC	Loss of Signal
	10TCC-PCTN-4GUS+10G	PCS layer	SFP/2G1/850I/MM/LC or SFP/2G5U/1310S/SM/LC	Non-valid line code as per ITU-T
	5TCE-PCTN-10GU+AES10G	PCS Layer	SFP/2G1/850I/MM/LC or SFP/2G5U/1310S/SM/LC	Loss of Signal

	2TWCC-PCN-2G7U	Physical layer	SFP/2G1/850I/MM/LC or SFP/2G5U/1310S/SM/LC	Loss of Signal
Gigabit Ethernet	4TCA-PCN-4GU+4G	PCS layer	SFP/2G1/850I/MM/LC or SFP/2G5U/1310S/SM/LC	K30.7 (8B/10B code word) as per ITU-T G.7041 and IEEE802.3
	4TCA-PCN-4GUS+4G	PCS layer	SFP/2G1/850I/MM/LC or SFP/2G5U/1310S/SM/LC	K30.7 (8B/10B code word) as per ITU-T G.7041 and IEEE802.3
	5TCE-PCTN-10GU+10G	PCS Layer	SFP/2G1/850I/MM/LC or SFP/2G5U/1310S/SM/LC	Loss of Signal
	5TCE-PCTN-10GU+AES10G	PCS layer	SFP/2G1/850I/MM/LC or SFP/2G5U/1310S/SM/LC	Loss of Signal
	10TCC-PCTN-4GUS+10G	PCS layer	SFP/2G1/850I/MM/LC or SFP/2G5U/1310S/SM/LC	Default setting: K30.7 (8B/10B code word) as per ITU-T G.7041 and IEEE802.3. Alternatively, Loss of Signal can be requested on CRF
	2TWCC-PCN-2G7U	PCS layer	SFP/2G1/850I/MM/LC or SFP/2G5U/1310S/SM/LC	K30.7 (8B/10B code word) as per ITU-T G.7041 and IEEE802.3
STM-4	4TCA-PCN-4GUS+4G	client signal not modified	SFP/2G5U/1310S/SM/LC	Loss of Signal
	WCC-PC1N-2G7U	client signal not modified	SFP/2G5U/1310S/SM/LC	MS-AIS
	10TCC-PCTN-4GUS+10G	client signal not modified	SFP/2G5U/1310S/SM/LC	Loss of Signal
STM-1	4TCA-PCN-4GUS+4G	client signal not modified	SFP/2G5U/1310S/SM/LC	Loss of Signal
	WCC-PC1N-2G7U	client signal not modified	SFP/2G5U/1310S/SM/LC	MS-AIS
	10TCC-PCTN-4GUS+10G	client signal not modified	SFP/2G5U/1310S/SM/LC	Loss of Signal
STM-16	WCC-PC1N-2G7U	client signal not modified	SFP/2G5U/1310S/SM/LC	MS-AIS
	10TCC-PCTN-4GUS+10G	client signal not modified	SFP/2G5U/1310S/SM/LC	Loss of Signal
	2TWCC-PCN-2G7U	client signal not modified	SFP/2G5U/1310S/SM/LC	MS-AIS

ISC-3 Peer Mode (2.125G)	5TCE-PCTN-10GU+10G	PCS layer	SFP/2G1/850I/MM/LC or SFP/2G5U/1310S/SM/LC	Loss of Signal
	5TCE-PCTN-10GU+AES10G	PCS layer	SFP/2G1/850I/MM/LC or SFP/2G5U/1310S/SM/LC	Loss of Signal
OTU1	WCC-PC1N-2G7U	client signal not modified	SFP/2G5U/1310S/SM/LC	AIS-ODU
	2TWCC-PCN-2G7U	client signal not modified	SFP/2G5U/1310S/SM/LC	AIS-ODU

Table 2. FSP3000 Customer Interface options

5.2 Transparency and Error propagation

The OSA service is designed to provide as much transparency as possible. OTN and SDH overhead bytes are not modified by the service. PCS layer transparency allows not only Ethernet and Fibre Channel bytes to be transported, but also the IFG (also known as IPG) to be transported. Physical layer transparency description in the Table 2 is used to indicate that transport is at the binary level. As transport of Ethernet occurs below layer 2, (at line code/PCS level or physical layer), layer 2 Ethernet control protocols are transported transparently.

Transport of Fibre Channel frame sizes greater than 2148 bytes, and Ethernet frame sizes greater than 9600 bytes, is not supported.

In the event of a failure of a client input at one end of the link, an error signal will be propagated to the far end client port. In the event of a wavelength / bearer failure, an error signal will be generated on the NTE's client port at both ends of a link. In most cases this error propagation signal will be an International Standards defined error signal for some cards, for other cards this will be a laser off/Loss of Signal condition.

It is strongly advised that interconnecting equipment with Loss of Signal error propagation behavior is avoided as this scenario will greatly complicate the re-establishment of end to end connectivity.

5.3 Fibre

For services employing a single-mode interface, all fibre optic connections to and from the patch panel will use single-mode fibre 9/125 micron according to ITU-T G.652.

For services employing a multimode interface, all fibre optic connections to and from the patch panel will use multimode fibre 62.5/125 micron or 50/125 micron according to ITU-T G.651.

The maximum distances supported on 8G/10G multimode interfaces is dependent on the Modal Bandwidth specification of the multimode cable provided by the customer. Maximum 10G distances for various multimode cables types are provided in the table below. Distances for 8G interfaces are expected to be broadly similar.

Multimode cable operating distances

Multimode fibre type	**Multimode cable modal bandwidth (MHz•km)**	**Operating Distance (m)**
FDDI	160	26
OM-1	200	33
OM-2	400	66
OM-3	500	82
OM-4	2000	300

Table 3 **Multimode cable operating distances**

5.4 Transmission (FSP2000 only)

The NTE is capable of transporting data at 10 Gbit/s per wavelength on the aggregate point to point fibre link. Multiplexing is carried out by passive filter components that combine the light of up to 32 different optical channels using up to 32 different wavelengths on to a single fibre. De-multiplexing is carried out by passive filter components that break out the aggregate signal from a single fibre into (up to 32) optical channels.

- 10 Gbit/s channels are only offered on the first 16 wavelengths.
- The addition of 10 Gbit/s wavelengths to existing DWDM systems not already running 10 Gbit/s channels may require planned downtime of the service in order to add amplification and carry out fibre measurements. For systems carrying more than 16 wavelengths, there is no upgrade path to 10 Gbit/s.

5.5 Client Side Optics (FSP2000 only)

Table 4 provides details of the Optical power margins for both the Receive and Transmit interfaces of the client facing optical interfaces. Please note that the CP may be responsible for damage caused by exceeding the optical parameters listed.

ADVA		
Customer interface card type	**Valid Input Range**	**Expected Output from interface**

1310nm SFP (used on 2.5G and 2:1 GE/FC card)*	-16dBm to -3dBm	-10 to -3dBm
850nm SFP (used on 2.5G and 2:1 GE/FC card)	-15dBm to -3dBm	-10dBm to -3dBm
10Gig XFP 1310nm (used on 10G cards)	-10dBm to -0.5dBm	-6dBm to -1dBm
4:1 (low speed) (1310nm)	-5dBm to -28dBm	-16dBm to -21dBm

Table 4. Optical power margins (ADVA FSP2000)

5.6 Client Side Optics (FSP3000 only)

Table 5 provides details of the Optical power margins for both the Receive and Transmit interfaces of the client facing optical interfaces. Please note that the CP may be responsible for damage caused by exceeding the optical parameters listed.

ADVA		
Customer interface type	**Valid Input Range**	**Expected Output from interface**
XFP/10G/850I/MM/LC	-8.0dBm to -2dBm	-8.0dBm to -1dBm
SFP+/11GU/1310S/SM/LC	-12.0dBm to -2dBm	-6.0dBm to 0dBm
SFP+/11GU/850I/MM/LC	-10.0dBm to 0dBm	-8.0dBm to -1dBm
SFP+/10G/1310S/SM/LC	-13.0dBm to -1.0dBm	-8.0dBm to -0.5dBm
XFP/11G/1310S/SM/LC	-12.0dBm to -2.0dBm	-6.0dBm to -1.0dBm
XFP/8G/1310S/SM/LC	-9.0dBm to -0.5dBm	-6.0dBm to -1.0dBm
SFP/4GU/850I/MM/LC	-13.0dBm to -1.0dBm	-10.0dBm to -2.5dBm
SFP/4GU/1310S/SM/LC	-14.0dBm to -2.0dBm	-9.0dBm to -1.0dBm
SFP/2G1/850I/MM/LC	-14.0dBm to -4.0dBm	-10.0dBm to -3.0dBm
SFP/2G5U/1310S/SM/LC	-17.0dBm to -1.0dBm	-5.0dBm to 0.0dBm

Table 5. Optical power margins (ADVA FSP3000)

6. NTE Power Requirements

The NTE will require two 240 Volt AC power supplies using 13 Amp switched sockets which must be provided within 1.5 metres of the NTE chassis for each chassis provided. A 240 Volt AC power supply using a 13 Amp switched socket is also required within 1.5 metres of the Openreach remote Network Management equipment.

If the customer wishes the NTE to be powered from a 48V DC supply, it is the customer's responsibility to provide and maintain this supply.

In addition to the NTE power requirements a 50Hz AC mains supply 13amp socket should also be provided, in close proximity to the NTEs, to power Openreach test equipment during both initial commissioning and subsequent maintenance support activities.

7. FSP3000 NTE Cooling Requirements

The maximum power consumption figure for FSP3000 7U chassis when fully loaded is 540W, and for a fully loaded 1U chassis the power consumption figure is 140W.

Where high density deployments of FSP3000 chassis are expected, the environmental cooling must be assessed to ensure that is sufficient sized for such deployments. For this reason, it is not recommend to house more than three 7U high FSP3000 chassis or twelve 1U high FSP3000 chassis in one cabinet, or indeed any combination of equipment, with power consumption exceeding more than 1800W.

8. Applications

ESCON, FICON and Coupling Link are proprietary storage area protocols from IBM, and are used in many SAN customer sites. ESCON is not supported on the FSP3000. Currently only the ISC-3 peer mode (2.125Gbit/s) variant of Coupling Link is supported on FSP3000.

9. Further Information

For enquiries concerning connection availability between particular sites and for further product information about this service please visit the website at www.openreach.co.uk or contact your Openreach Customer Business Manager or BT Account Manager.

If you have enquiries relating to this document then please contact: sinet.helpdesk@bt.com

10. References

ITU-T G.651	Recommendation G.651 (02/98) – Characteristics of a 50/125 ∝m multimode graded index optical fibre cable
ITU-T G.7041	Recommendation G.7041/Y.1303 - Generic Framing Procedure (GFP)
IEEE 802.3	IEEE Standard for Information technology-Telecommunications and information exchange between systems-Local and metropolitan area networks-Specific requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications
ITU-T G.652	Recommendation G.652 (04/97) - Characteristics of a single-mode optical fibre cable
Gigabit Ethernet	IEEE 802.3z or SIN 360 Gigabit Ethernet for the BT Network
Fibre Channel	ANSI/NCITS X3.288-1996 or SIN 345 Channel Extension Service 1000
2G Fibre Channel	Fibre Channel Physical interface (FC-PI), ANSI 212-642-4900 ANSI INCITS 352-2002
ESCON, FICON, FICON Express, Coupling Link, Sysplex Timers	IBM Proprietary as specified in IBM Red Book Standard for GDPS.

Please see information available at: http://www.btplc.com/sinet/ regarding the availability of standards.

11. Abbreviations

4CSM	4 Channel Splitter module
AC	Alternating Current
ANSI	American National Standards Institute
ASI	Asynchronous Serial Interface
ATM	Asynchronous Transfer Mode
CPE	Customer Premises Equipment
DC	Direct Current
DWDM	Dense Wavelength Division Multiplexing
ESCON	Enterprise Systems CONnectivity architecture [IBM]
ETR	External Time Reference
FICON	FIbre CONnectivity
IBM	International Business Machines
IFG	Inter Frame Group
IPG	Inter Packet group
IP	Internet Protocol
ISC	InterSystem Channel (Coupling Link)
ITU-T	International Telecommunication Union - Telecommunications Standardization Sector (formerly CCITT)
LAN	Local Area Network
Mbit/s	Megabits per second
Gbit/s	Gigabits per second
GDPS	Geographically Dispersed Parallel Sysplex [IBM]
MUX	Multiplexer
NCITS	National Committee for Information Technology Standards
NTE	Network Terminating Equipment
NTP	Network Terminating Point
OSA	Optical Spectrum Access
OSEA	Optical Spectrum Extended Access
OTN	Optical Transport Network" as described in ITU-T G.709 "Interfaces for the Optical Transport Network (OTN)
PCS	Physical Coding Sublayer as described in IEEE 802.3
PHY	Physical Layer
RO1	Resilience Option 1
RO2	Resilience Option 2

SAN	Storage Area Network(s)
SC	Structured Connector
SDH	Synchronous Digital Hierarchy
SIN	Suppliers' Information Note
SONET	Synchronous Optical Network
STM	Synchronous Transport Module
VSM	Versatile Switch Module
WAN	Wide Area Network

12. History

Issue	Date	Changes
Issue 1.0	4 December 2008	First issue
Issue 2.0	January 2011	Text amended to reflect withdrawal of Nortel as a OSA supplier
Issue 3.0	January 2012	Introduction of FSP3000 NTE
Issue 3.1	March 2012	Editorial changes made to section 5 in support of Issue 3.1
Issue 3.2	November 2012	Editorial changes to Table of content , update to URL in 3.1, Amendment in customer interface section 5.1 and. Heat limits added in new section 7.
Issue 3.3	March 2013	Amended to advise no longer available for new supply w.e.f 1 April 2013
Issue 3.4	July 2013	Addition of ISC-3 protocol
Issue 3.5	July 2015	Change SINet site references from http://www.sinet.bt.com to http://www.btplc.com/sinet/
Issue 3.6	Mar 2017	Inclusion of Encryption service card. Inclusion of Multi-mode cable operating distances.
Issue 3.7	Dec 2017	Inclusion of 5x10 gb wavelength card 5WCA-PCN-16GU

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