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Suppliers' Information Note

For The BT Network

Ethernet Access Direct (EAD) 10000

Service & Interface Description

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1. Introduction

This Suppliers' Information Note (SIN) describes the interface provided with the Openreach 10 Gbit/s Ethernet Access Direct (EAD) services, referred to as EAD 10000. Also provided is some general information on the EAD product family and some physical aspects of the NTE being deployed for Ethernet Access Direct 10000 customer orders.

EAD services are high speed, point-to-point data circuits that are permanently connected and available 24 hours a day, 365 days a year. EAD provides secure links between combinations of end user sites, Communications Providers' (CPs') sites and BT exchanges. The EAD Local Access product provides a secure link between an end user site or a CP site and the fibre serving BT exchange site, with the circuit terminating at a CP presence at that serving exchange (e.g. BT Locate space).

Any specific technology mentioned in this document is current as of today. However, it may be subject to change in the future. Should the specification of the interface be changed, this will be notified by a new issue of this SIN. Openreach reserves the right to adapt technology to deliver EAD and EAD Local Access services as new developments are made. All services are delivered over an uncontended transmission path.

2. Service Description

The EAD service is a point-to-point data service offering high bandwidth connectivity over a standard radial distance up to 25km between sites. This radial (or point-to-point) distance can result in physical line plant route distances of up to 40 km.

Extended Reach options (i.e. above 40km radial distance) are not available for EAD 10000 circuits.

EAD offers to provide a secure link between a combination of end user sites, Communication Provider's (CP's)network at a CP's sites and BT exchanges, with the circuit terminating at a CP presence at that serving exchange (e.g. BT Local space).

Synchronous Ethernet (SyncE) is an optional feature of the EAD service available via the Openreach EMP platform only. SyncE is available for EAD 10000 services for Local Access and Standard Reach, including Resilience Options.

EAD SyncE will transport a clock input through the network to produce a matching clock output at the other end of the service. Providing and maintaining the timing source is the CP's responsibility.

EAD Local Access only provides access as far as the fibre serving exchange and, as this is the only exchange involved, radial distances between exchanges are not applicable. EAD Local Access provides a secure link between either an end user site or Communication Provider's (CP's) network at a CP's site and the fibre serving BT exchange site, with the circuit terminating at a CP presence at that serving exchange (e.g. BT Locate space).

For enquiries concerning connection availability between particular sites and for further information on the EAD service please contact your Openreach Sales Relationship Manager or refer to the EAD Product description, available on the Openreach web site.

The client interfaces offered on the 10Gbit/s EAD services (including SyncE), i.e. the NTE are shown in the table below. The interfaces are based on LAN PHY as described in 802.3 [2]

Product Selected	EAD/EAD Local Access 10000
Interface(s) Offered	10GBase-LR (SMF) (10 Gigabit Ethernet LAN PHY) 10GBase-SR (MMF) (10 Gigabit Ethernet LAN PHY)
Connector Types	Dual LC

Table 1. Client Interfaces

Client interfaces offered on the EAD 10000 NTE are Full Duplex only in line with IEEE standards for 10Gbit/s Ethernet. The uncontended transmission path is routed via the Openreach network.

A schematic of the EAD 10000 service is shown in Figure 1 and EAD Local Access is shown in Figure 2. The diagrams depict current technology and delivery, and this is subject to change. In each case the management router will normally be located at the A end, but in certain circumstances may be located at the B end, but not at both ends.

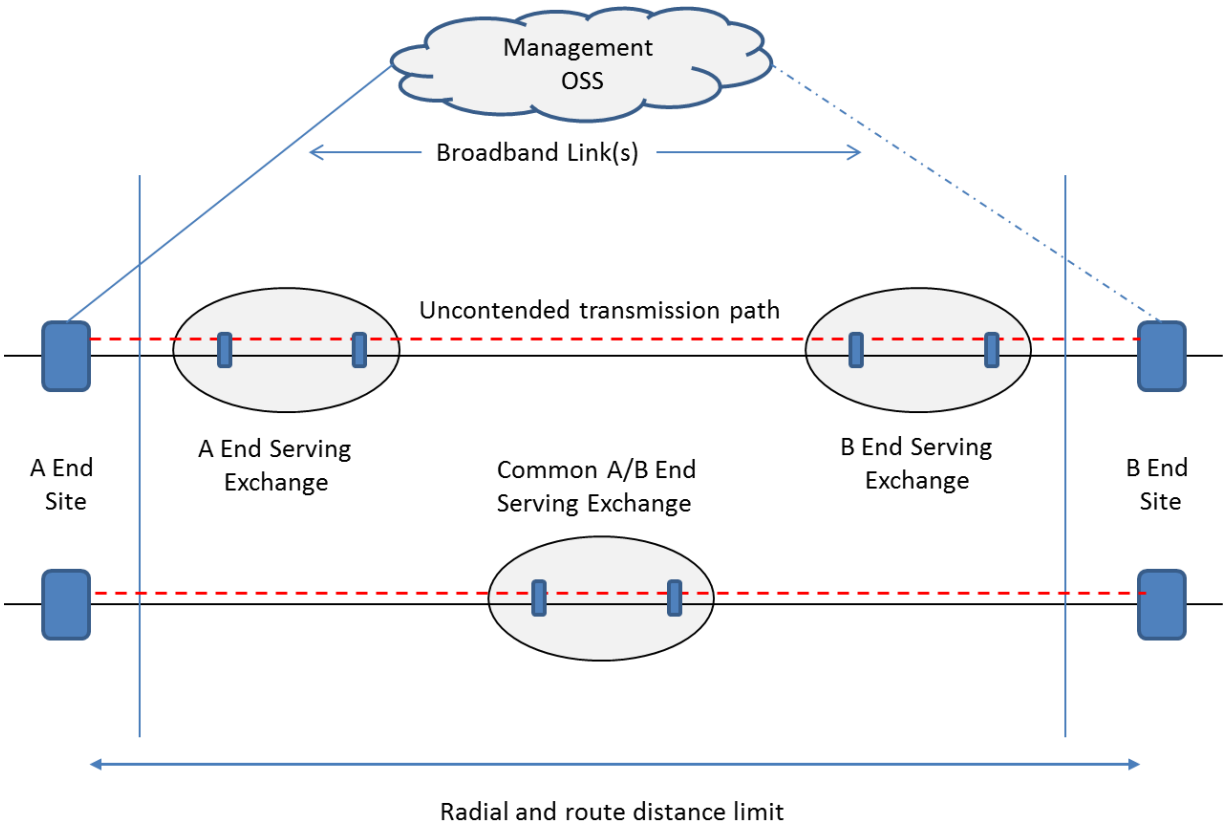

Figure 1. EAD 10000 Service Configuration

Note. Figure 1 depicts two separate circuit scenarios, not a combined service. The upper schematic represents an EAD circuit where each end is served from different BT exchanges. The lower schematic represents an EAD circuit where each end has a common BT serving exchange.

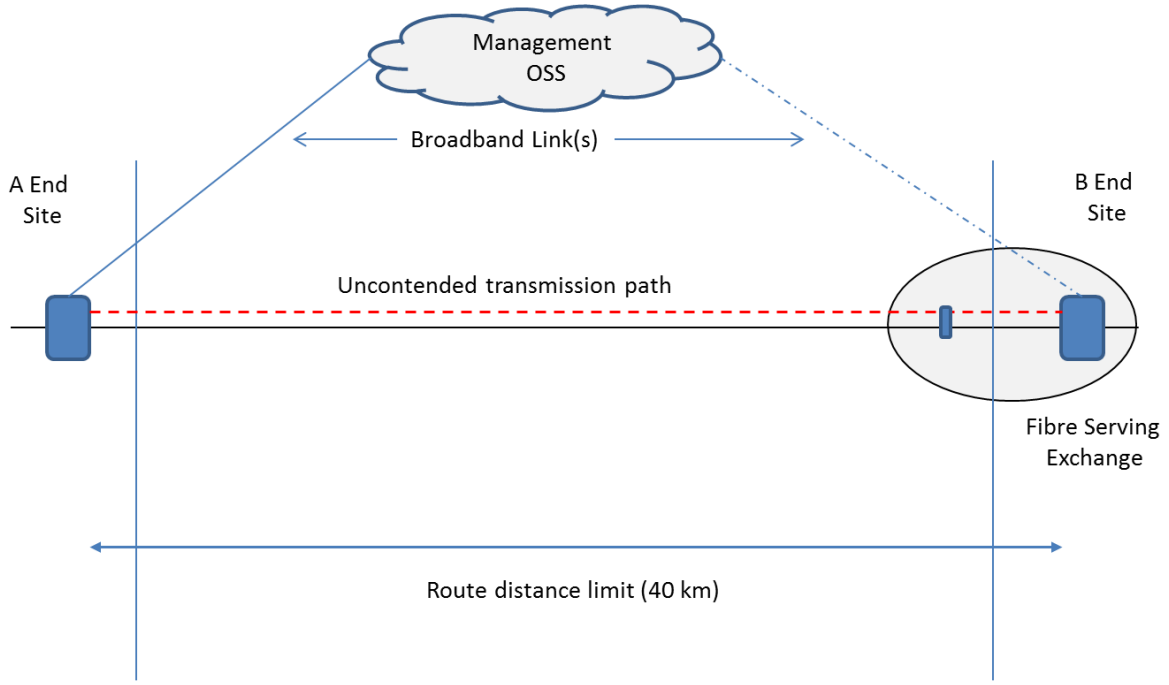

Figure 2. EAD 10000 Local Access Service Configuration

The EAD/EAD Local Access services are connected for operational support purposes to an Openreach management platform.

3. EAD 10000 Service Features

3.1 General

The 10G EAD NTE is capable of transmitting frames conforming to IEEE 802.3 [2] with frame sizes from 64 bytes to a maximum of 2000 bytes. This is to maintain compatibility with a number of frame tagging formats, including VLAN tagging as specified in 802.1Q [4].

The service is transparent to VLAN tags and will forward VLAN tagged frames in the same way as standard (untagged) frames.

On a 10Gbit/s SyncE enabled service one additional frame per second will be sent with the customer traffic on the same remote end access port to provide information on the status of the synchronisation.

Due to the use of a 4 byte overhead for management purposes an EAD 10000 circuit is expected to have a reduction of throughput of up to 1% for Customer frame sizes of 400 bytes and above. For customer Ethernet frame sizes smaller than 400 bytes the throughput reduction increases to approximately 6% for 64 byte frames.

Note: The EAD 10000 NTE will pass 9000 byte frames, however as this is not yet a recognised Ethernet standard BT will not validate usage at this level until such time as the IEEE provide an endorsement and published standard for jumbo frames and we have tested against it.

3.2 Frame Forwarding Behaviour

The EAD 10000 service does not include IEEE 802.d [3] Bridging functionality, which allows for the Learning and Filtering of traffic packets destined for those hosts connected at the local end.

Therefore Ethernet frames that would normally be filtered by 802.1d [3] bridging functionality are instead forwarded across the EAD link.

3.3 EAD 10000 Transparency Restrictions

All Ethernet frames are passed across the EAD link, other than the following list of known exceptions:

1. Transport of EFM OAM PDUs as defined by IEEE 802.3 [2] over EAD is not supported.

   The EAD service uses EFM OAM PDUs internally for the purposes of OAM. And as per the IEEE 802.3 [2] standards defined behaviour for EFM equipment, the end to end transport of customer EFM OAM PDUs over the EAD link is blocked.

2. Transport of Ethernet flow control / Pause frames over EAD is not supported.

3. IEEE 802.1ag [1]/ITU-T Y.1731 [10]) is transparent as long as the Customer does not use MD levels 0 or 1.

3.4 Auto-Negotiation and Duplex Settings

In contrast to lower rate Ethernet signals (10, 100 and 1000Mbit/s) the 10Gbit/s Ethernet service, in line with standards, does not support auto-negotiate to advertise speed and duplex settings. Instead the speed is set to 10Gbit/s and the service is "Full Duplex". Half duplex operation is not supported.

3.5 Link Loss Forwarding

The EAD 10000 NTE is offered with both Network Link Loss Forwarding and user Link Loss Forwarding. Network Link Loss Forwarding is applied to the network service by default. The User Link Loss forwarding is a selectable option, as is the link failure direction (i.e. A to B end or B to A end).

3.5.1 Network Link Loss Forwarding

When a break is detected on the Openreach network link, the client interface port is shut down to indicate the state of the infrastructure. This continues until such time as the network break is repaired.

3.5.2 User-User link Loss Forwarding

User-User Link Loss Forwarding allows the notification of failure of an NTE at one end of an EAD 10000 service to be propagated to a suitably configured customer device at the other end of the same service. Available as a selectable unidirectional service only, User Link Loss Forwarding is notified at the time of provision.

For EAD customer to CP connections, it is recommended that this functionality is activated from the CP's PoP to the End User customer site. This means that the EAD circuit is only impacted by User Link Loss Forwarding only if problems occur at the CP's equipment at the

CP PoP site end of the circuit. If problems occur at the end user customer's equipment, the circuit will not be impacted.

Where User-User Link Loss Forwarding is present on an EAD 10000 SyncE service the intrusive remote test may not operate correctly unless active customer connection is made at both ends of the service.

3.6 **Synchronous Ethernet**

EAD 10000 SyncE will transport a clock input through the network to produce a matching clock output at the other end of the service. Providing and maintaining the timing source is the CP's responsibility. EAD 10000 SyncE supports;

- Synchronisation at the Physical layer, ITU-T G.8261 [6]
- Supports clock requirements at as specified in ITU-T G.8262 [7]
- Supports messaging requirements as specified in ITU-T G.8264 [8]
- BITS interface compliant to ITU-T G.703 [9]
- For any circuit, only one end can be the timing source; daisy chaining of timing is not supported
- Multiple timing domains on the NTE are not supported

Timing Input Options

BITS SSM is the only supported Synchronisation Input option. BITS OUT is enabled on the remote end of the service.

Timing for synchronisation can be provided via a BITS IN/OUT port configured as a BITS IN interface by means of an external clock directly cabled from, for example, an SSU (Station Synchronisation Unit).

The SyncE configuration is as listed below;

- Line Type: E1
- Line Code: E1 HDB3
- Frame Format: E1 CRC4
- SA Bit: Bit 4
- QL mode enabled

For EAD 10000 SyncE the T1/E1 External Clock Input/Output connector (labelled BITS I/O) is a front mounted RJ45 connector. Refer to the following table for the BITS IN/OUT connector pin assignments.

Pin Number	Signal	Description
1	RRING	Receive Ring
2	RTIP	Receive Tip
3	GND	Ground
4	TRING	Transmit Ring

5	TTIP	Transmit Tip
6	-	
7	-	
8	-	

Table 2. BITS IN/OUT connector pin assignment

4. Customer Interfaces

4.1 General

The customer equipment Ethernet interface must conform to IEEE 802.3[2]. The following two interfaces are supported:

10GBASE-SR, [850 nm multimode serial LAN PHY]

10GBASE-LR, [1310 nm single-mode serial LAN PHY]

4.2 Connector

The client interface is the Network Termination Point (NTP), i.e. the point of connection on the Openreach Network Terminating Equipment (NTE) for connecting CPE or CP equipment. This is the Service demarcation point between the Openreach network and the customers' equipment.

The client interface consists of dual LC sockets as specified in the IEEE 802.3[2] specifications.

The CP or End User provides the suitable connecting cords between the NTE and their own equipment. For multimode fibre cabling used on the 10GBASE-SR interface, this is limited to a maximum cable length based on the bandwidth specification of the multimode cable:

Multimode cable bandwidth (MHz•km)	Operating Distance (m)
160	26
200	33
400	66
500	82
2000	300

Table 3. Multimode cable operating distances

For single-mode fibre cabling used on the 10GBASE-LR interface, this is limited to a maximum cable length of 10000 metres.

5. Transmission

The NTEs connected to the Openreach network provide an uncontended transmission path.

6. Environmental Specifications

The Temperature and humidity range of the environment used to house the NTE must not exceed the following:

- Ambient room temperature: 0°C to +40°C
- Relative humidity 5% to 95%
- Passive Cooling

Please refer to the EAD product description for details of physical space requirements.

EAD product description can be found at:
https://www.openreach.co.uk/orpg/customerzone/products/ethernetservices/ethernetaccessdirect/description/productdescription.do

The dimensions of the 1U high NTE are (443mm x 44.4mm x 220mm WxHxD)

Weight 5.6 kg

7. Power Supply

7.1 General

By placing an order with Openreach the customer has accepted the conditions placed by BT in relation to providing power, as defined below:--

In relation to powering of equipment, the customer must comply with the requirements of BS7671 [11] and the details given within the "DC Power Planning and Installation Guide for WES-BES Products' document.

The Openreach NTE is locally powered and offers AC or DC power options. The CP will be required to provide either dual local 50Hz AC supply in the form of standard 13 Amp power socket(s); or dual -50 V DC power distributions and Earth connections, with all wiring colour schemes conforming to BS7671 [11] . It will be the customer's responsibility to ensure that the power supplies are fused and safe for Openreach to use. These should be in close proximity to the NTE installation location.

7.2 Installation and Testing

In addition to the NTE powering requirements (i.e. AC or DC power as defined below) , a spare 50 Hz AC mains supply 13A socket should also be provided in close proximity to the NTEs' to power BT test equipment during both initial commissioning and subsequent maintenance support activities. A 50 Hz mains supply 13A socket should also be provided in close proximity to the NTE for the management router.

7.3 AC Power connection

AC power connection between Openreach equipment and the power socket will be made using a power lead fitted with a standard 13A plug. The NTE itself has dual power supply units internally, and requires two AC mains supply sockets running off the same phase.

For most installations, this will require two mains connections for each NTE provided, and the consumption of the Openreach NTE in this managed service arrangement will typically be 63 watts per NTE. An additional AC mains supply socket will be required for the management router.

7.4 DC Power Connection

The DC in-Line (Molex) connector is specified as the standard method of connecting DC power by Openreach, and represents the "Demarcation Point" between Openreach and the customer. At is site the customer is required to provide suitable power and earth connection to, and be responsible for the supply, wiring and labelling to, the demarcation point. Openreach will not supply or install the DC distribution system as part of the standard Ethernet installation.

7.4.1 Customer-provided wiring up to the Openreach specified In-Line Connector

Wiring, MCB isolation or fuse (i.e. C type MCB or Cartridge Fuse) must be provided by the customer, up to and including the DC in-line connector, as per BT's requirements stated within the DC Power Planning and Installation Guide for WES-BES Products document with respect to;

i. Correctly rated MCB/Fuse (6A),
ii. Correct labelling of wiring and MCB/fuse positions compliant with BS 7671 [11]
iii. Correct size of cable for required voltage drop at required maximum current
iv. Separately fused isolatable A & B power supplies, as detailed in the 'AC/DC Power Planning and Installation Guide' document

An additional AC mains supply socket will be required for the management router. Currently the management router is AC powered only.

7.5 Additional Details

For further details on the provision of DC power see the 'AC_DC_power_planning_installation_issue_10' available on the Openreach Ethernet website.

If there is a conflict between DC power information contained in the 'AC/DC Power Planning and Installation Guide' and the SIN document, the order of precedence shall be as follows:

(a) AC/DC Power Planning and Installation Guide
(b) SIN

8. Further Information

For enquiries concerning connection availability between particular sites and for further "sales and marketing" information on EAD 10000 services, please contact your Openreach Sales Relationship Manager or see the Openreach site listed on the SINet Useful Contacts page at http://www.btplc.com/sinet/

9. References

[1]	IEEE 802.1ag	Connectivity Fault Management	2007

[2]	IEEE 802.3	IEEE Standard for Ethernet	2012
[3]	IEEE802.1d	IEEE Standard for Local and metropolitan area networks: Media Access Control (MAC) Bridges	2011
[4]	IEEE 802.1Q	IEEE Standard for Local and metropolitan area networks--Media Access Control (MAC) Bridges and Virtual Bridges	2012
[5]	SIN 432	Openreach Wholesale Extension Services 10 and Wholesale end-to-end services Local Reach (WES/WEES 10LR)	2009
[6]	ITU-T G.8261	Timing and Synchronisation Aspects in Packet networks	2013
[7]	ITU-T G.8262	Timing Characteristics of a synchronous Ethernet equipment slave clock	2007
[8]	ITU-T G.8264	Distribution of timing information through packet networks	2014
[9]	ITU-T G.703 (2M)	Physical/electrical characteristics of hierarchical digital interfaces	2001
[10]	ITU-T Y.1731	OAM functions and mechanisms for Ethernet based networks	2013
[11]	BS7671	Requirements for electrical installations. IEE Wiring Regulations. Seventeenth edition	2008 – 2011

For further information or copies of referenced sources, please see document sources at: http://www.btplc.com/sinet/Documentsource/index.htm

10. **Abbreviations**

10GBase-LR	10 Gbit/s Ethernet over Fibre for LAN, Long Reach interface as defined in 802.3
10GBase-SR	10Gbit/s Ethernet over Fibre for LAN, Short Reach interface as defined in 802.3
BITS	Building Integrated Timing Supply
CP	Communications provider (Providers of Electronic Communication Services)
CPE	Customer Premises Equipment
EAD	Ethernet Access Direct
EFM	Ethernet in the First Mile
EMP	Equivalence Management Portal

ESM	Ethernet Synchronisation Message
Gbit/s	Giga (10^9) bits per second
IPR	Intellectual Property Rights
ITU-T	International Telecommunications Union for Telecommunications (formerly CCITT)
LAN	Local Area network
LLF	Link Loss Forwarding
MAC	Media Access Control (& hardware Device Address)
Mbit/s	Mega (10^6) bits per second
MCB	Mini Circuit Breaker
MDI	Media Dependent Interface
MMF	Multi-Mode Fibre
NTE	Network Terminating Equipment
NTP	Network Terminating Point
OAM	Operations Administration and Management
PDU	Protocol Data Unit
SIN	Suppliers' Information Note
SMF	Single Mode Fibre
SSM	Sync Status Message
VLAN	Virtual Local Area Network

11. History

Issue	Date	Details
1.0	July 2015	First issue

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