



CESAR²

Sub appendix
Access specification
ETHERNET

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1. Product ETHERNET

1.1 Overview of Access Specification Ethernet (Attributes)

The product type, Ethernet, include the following products.

Product type: Active Access				
ATTRIBUTES	PRODUCTS			
	Ethernet Light	Ethernet Medium	Ethernet Premium	Ethernet Access MEF (EA-MEF)
Relevant standards	-	-	MEF 6.2, 10.3, 23.1	MEF 6.2, 10.3,23.1
Unicast Frame Delivery	Yes, unconditionally	Yes, unconditionally	Yes, unconditionally	Yes, unconditionally
Multicast Frame Delivery (read 4.5.1.13 if terms)	Yes, unconditionally	Yes, unconditionally	Yes, unconditionally	Yes, unconditionally
Broadcast Frame Delivery (read 1.5.1.13 if terms)	Yes, unconditionally	Yes, unconditionally	Yes, unconditionally	Yes, unconditionally
Tunnel Ethertype 0x86DD (IPv6)	No	Yes, (1.5.1.5)	Yes, (1.5.1.5)	Yes, (1.5.1.5)
VLAN ID Preservation	No, no VLAN	Yes	EPL: always EVPL: Yes/No (1.5.1.9)	EPL: always EVPL: Yes/No (1.5.1.9)
VLAN CoS Preservation	No, no VLAN	Option Yes/No No =default (1.5.1.7)	EPL: always EVPL: Yes/No (1.5.1.7)	EPL: always EVPL: Yes/No (1.5.1.7)
DSCP preservation	No	Yes, (1.5.1.7)	Yes, (1.5.1.7)	Yes, (1.5.1.7)

ATTRIBUTES		PRODUCTS			
		Ethernet light	Ethernet Medium	Ethernet Premium	EA-MEF
L2CP according to MEF 45, "Multi-CEN Layer 2 Control Protocol"		No	No	Yes, (1.5.1.8)	Yes, (1.5.1.8)
*1⁽¹⁾ Linktrace message (802.1ag Eth OAM) (1.5.1.12)		No	No	Option yes/no Yes: Tunnel*1 ⁽¹⁻⁴⁾	Option yes/no Yes: Tunnel*1 ⁽¹⁻⁴⁾
*1⁽²⁾ Tunnel Connectivity Check messages (CCP)		-	-	Yes	Yes
*1⁽³⁾ Tunnel Linktrace messages (LT)		-	-	Yes	Yes
*1⁽⁴⁾ Tunnel uni/multicast Loopback messages (LB)		-	-	Yes	Yes
*2 Support for *1 ⁽¹⁾ Linktrace message (802.1ag eth OAM), *1 ⁽²⁾ Tunnel connectivity Check message (CCP), *1 ⁽³⁾ Tunnel Linktrace messages (LT) and *1 ⁽⁴⁾ Tunnel uni/multicast Loopback message (LB) must be applied					
EVC Performance	City (Metro) (<250km)	FLR<1% FD<100 ms FDV≤25ms	FLR ≤0.01% FD≤20 ms FDV≤15 ms	FLR ≤0.01% FD≤20 ms FDV≤8 ms	FLR ≤0.01% FD≤10 ms FDV<3 ms
	Sweden (Regional) (<1200km)	FLR<1% FD≤100 ms FDV≤40ms	FLR≤0.01% FD≤75 ms FDV≤40 ms	FLR≤0.01% FD≤75 ms FDV≤40 ms	FLR≤0.01%, FD≤25 ms FDV≤8 ms
One CoS defined					
Notice: FLR=Frame Loss Ratio (Packet loss) FD=Frame Delay FDV=Frame Delay Variation (jitter), read 1.5.2.2 -- 4					
Ethernet/EVC MTU size		≤1518 (1.5.2.6)	≥1534 bytes option 1522 bytes (1.5.2.6)	≥1534 ≤ 9000 bytes (1.5.2.6)	≥1534 ≤ 9000 bytes (1.5.2.6)
Number of MAC-adresses (MAC)		5	≥5 ≤100 * Part of a region access ≥ 200	100 *Part of a region access ≥ 200	100 *Part of a region access ≥ 200
A regional access is a connection which terminates with A-and B-points in different counties. E.g. region-cluster network. A connection which belong to a national backbone can also be called regional connection.					
Duplex mode on interface (1.5.1.10 -- 11)		auto-negotiation Default: Full	auto-negotiation Default: Full	Full	Full
Classes of Service (CoS)		-	-	One CoS definerad	One CoS definerad

ATTRIBUTES	PRODUCTS			
	Ethernet Light	Ethernet Medium	Ethernet Premium	EA-MEF
Test (by 1.5.5)	Yes	Yes, describe what is	Yes, full spec.	Yes, full spec.
Testprotocol at delivery (Service turn-up test suite)	No (1.5.5)	being tested No (1.5.5)	Yes (1.5.5)	Yes (1.5.5)

1.2 Access specification Ethernet Light

Specification

This service is suitable for replacing copper and wireless services with a fiber based service to deliver ethernet service to a smaller business.

For technical functionality, read table 1.1 Overview of service specification Ethernet and for Options/Variables, read table 1.6

1.3 Access specification Ethernet Medium

Specification

This service is suitable for offering Ethernet transport to small- and medium sized business.

For technical functionality, read table 1.1 Overview of service specification Ethernet and Options/Variables, read table 1.6

Picture: Specification of VLAN-tag function for Ethernet Medium

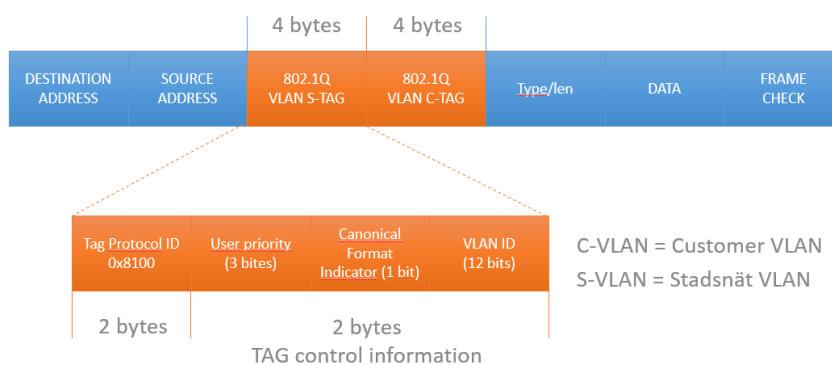
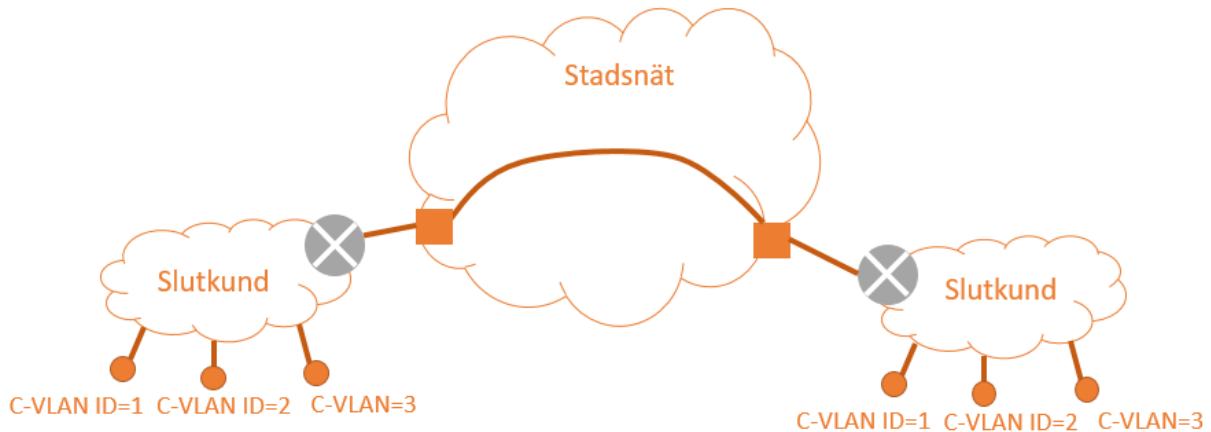


Figure: Example of configuration



1.4 Access specification Ethernet Premium

Description

This service is suitable as an alternative to leased Dark fiber accesses. Specifications are almost equal Ethernet Access MEF, read 1.5

What differs from the Ethernet Access MEF are the EVC-value, i.e.

- FLR, Frame Loss Ration (Packet loss)
- FD, Frame Delay
- FDV, Frame Delay variation

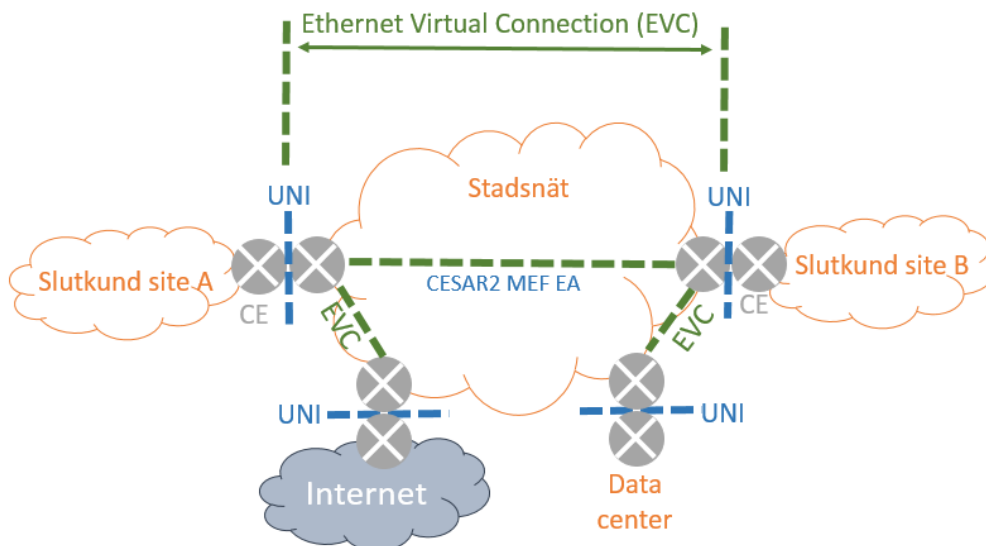
Premium does not have as high demands as of a service product according to 1.5. There is no demand for Management-VLAN.

For technical functionality, read table 1.1. Overview of service specification Ethernet and Options/Variables, read table 1.6

1.5 Access description Ethernet Access MEF

Both parties have ambitions that the leased connections deliver according to the Metro Ethernet Forum's standards MEF6.2 and MEF10.3 for Ethernet Virtual Private Line (EVPL) and Ethernet Private Line (EPL). The reason for this position is to achieve as correct probability as possible of how a leased ethernet connection works when it comes down to functionality and performance. In this document different parts of the MEF6.2 and MEF10.3 are referred to consistently where relevant.

Figure: Basic terms

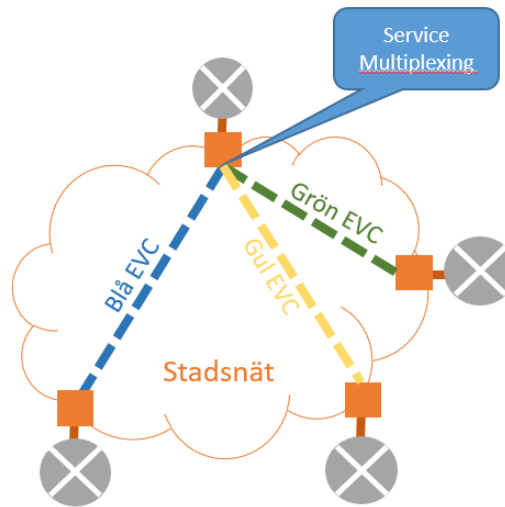


Two technical solutions are accepted:

1. **E-line EPL** are being delivered with separate ethernet interface in both ends of the Connection. One or several EVC:s are established above the EPL by agreement between the Buyer and the Seller.
2. **E-line EVPL** are being delivered with ethernet interface at the end-customer, but with joint ethernet interface towards the Buyer. Several end-customers connects to the Buyer's net through a joint ethernet connection and are separated on the VLAN.

The Seller shall support Q-in-Q per EVC (so the Buyer are able to deliver a Layer2-end-to-end solution in the end).

Figure: Examples of configuration of EVPL



The figure shows three EVC:s, established through a joint transfer point. The EVC:s multiplexes based on VLAN. This equals solution 2, E-line EVLP and is preferred to the buyer.

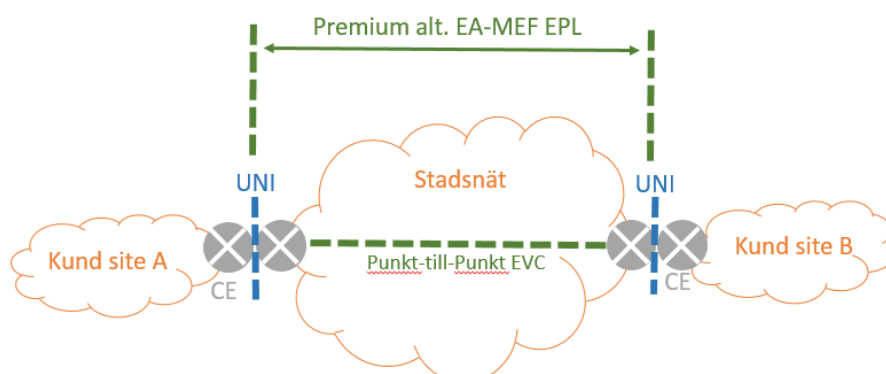
1.5.1 TECHNICAL SPECIFICATION, PERFORMANCE REQUIREMENTS

1.5.1.1 Outline of solution

The Seller should be able to present an outline of the net construction. The outline shall contain information of which underlying technique that has been used to implement the service.

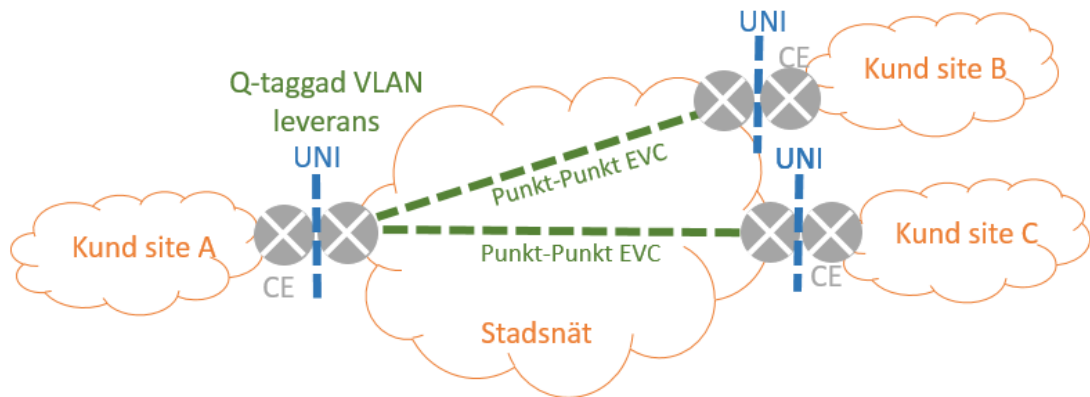
1.5.1.2 E-line EPL

A Connection of type EPL shall follow specification MEF6.2. The figure below shows how the Buyer wants different specified parameters to work.



1.5.1.3 E-line EVPL

An EVPL connection shall follow the specification of MEF6.2. There is a specification below of how the Buyer intend different specific parameters to function.



1.5.1.4 Operation and maintenance

It is possible for the Buyer to establish a separate EVPL/EPL for operation and maintenance of the set equipment. This requires a separate agreement.

1.5.1.5 Ethertype

Limitations of which ethertypes are supported by the Connection is specified by the Seller. The Ethertype 0x86DD for Ipv6 over the Ethernet, is supported by the Access (read RFC2464).

1.5.1.6 Bandwidth

Ingress Bandwidth Profile which is applied by the Access, shall apply per EVC and not per CoS ID. If an Ingress Bandwidth Profile is applied on the Access, following parameters must be specified as <CIR, CBS, EIR, EBS, CM, CF> (the parameters are specified in paragraph 7.11.1 i MEF10.2).

Practically this means that CIR = EIR to achieve the demand in chapter 1.5.2.1.

It also means that it is not necessary to support priority on the Access since all frames being sent above it, shall be guaranteed through the network of the Seller, according to the performance requirements in chapter 1.5.2.1

1.5.1.7 CoS and DSCP-value

Preservation of CE-VLAN CoS and DSCP is mandatory, i.e. the value may not be changed by the Seller if Yes is specified.

1.5.1.8 Layer-2 control protocol

The management of the layer-2 control protocol is to be operated according to MEF 45. This means that STP/RSTP/MSTP normally should be discarded.

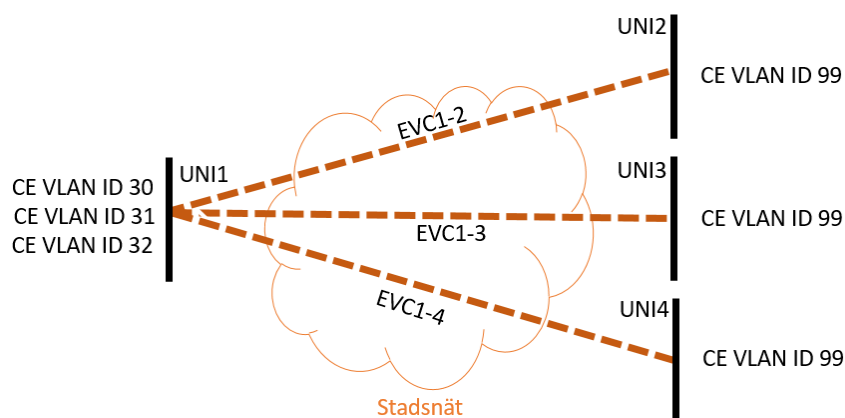
1.5.1.9 VLAN

There are two options of an ordered access regarding VLAN.

1.5.1.9.1) Transparent access with Service Multiplexing delivery point Without Bundling

An EVC is placed between the delivery point and the end-customer's UNI where all frames is be transported from the end-customer's UNI regardless tagged or untagged, and shall be delivered at a set VLAN at the Delivery UNI.

Figure: Example configuration VLAN ID Preservation=NO

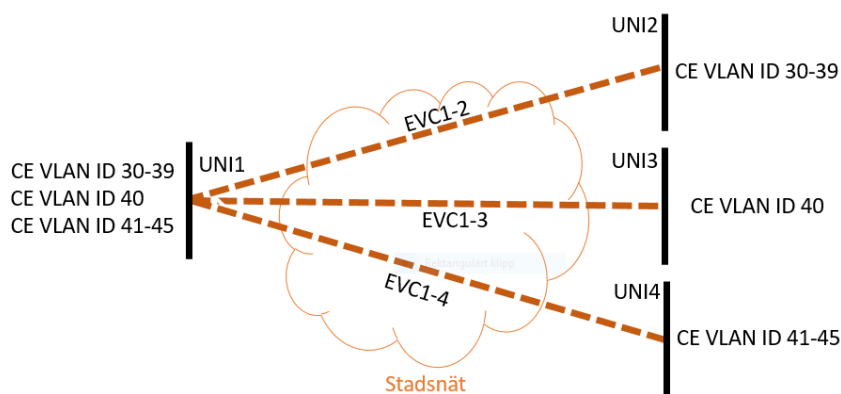


1.5.1.9.2 Transparent access with Bundling at Delivery point.

An EVC is placed between Delivery point and End-customer's UNI:s where a CE-VLAN ID/EVC Mapping is made. According to description in MEF 10.3.

The Seller shall also be able to provide a management-vlan per connected customer device.

Figure: Example configuration VLAN ID Preservation=YES



1.5.1.11 Interface for delivery point (Buyer)

The interface for delivery point in the Buyer's network, must be according to IEE 802.3 standards. On demand, the interface are to be configured according to the following:

1. 10 Mbps full-duplex
2. 100 Mbps full-duplex
3. 1000 Mbps full-duplex
4. 10 Gbps full-duplex

It must be specified which of Auto-negotiation or manual configuration is applied. The interface for each speed is to be,

1. 10Base-T, 10Base-F
2. 100Base-TX, 100Base-FX
3. 1000Base-T, 1000Base-X (standard is 1000Base-X)
4. 10GBase-SR, 10GBase -LR, 10GBase -ER

4.5.1.12 Ethernet OAM

Ethernet OAM according to MEF17 (based on IEEE 802.1ag and ITU-T Y.1731) is supported.

4.5.1.13 Multi-and Broadcast frame delivery

If the Seller has limitations or terms or tems for protection on the network, this must be clear according to 4.5.6, deviation from requirement specification.

1.5.2 TECHNICAL SPECIFICATION, PERFORMANCE REQUIREMENTS

1.5.2.1 Available bandwidth

The Seller must guarantee that the leased capacity of the Buyer is available through the Seller's network at the availability guaranteed of the Access.

1.5.2.2 Frame Loss Ratio

(Defined by MEF 6.2 Frame Loss Ratio)

The amount of lost ethernet frames through the network of the Seller must never exceed FLR = 0.01% counted over a period of T = 5 minutes. If controlled, there should be at least one measure point collected, one at the beginning and one at the termination of the period.

1.5.2.3 Frame Delay

(Defined by MEF 6.2 Frame Delay)

The delay of ethernet frames must not exceed $\leq 10\text{ms}$ for a distance $< 250\text{km}$ and $\leq 25\text{ms}$ for a distance $> 250\text{km}$ och $< 1200\text{km}$.

1.5.2.5 Arrangements of Ethernet frames (FIFO)

The Ethernet frame order must always be kept according to the model First In, First Out.

1.5.2.6 Frame size

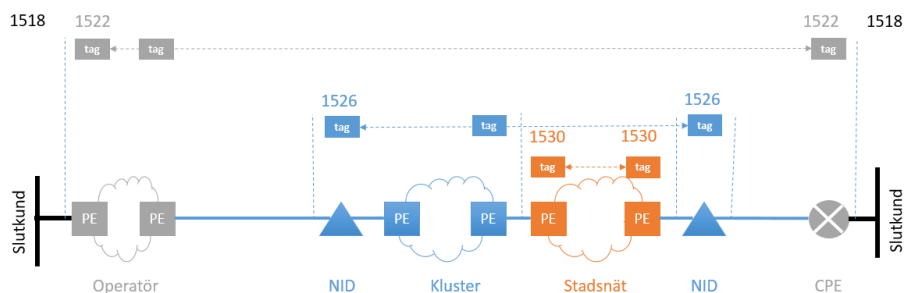
The frame size must follow each product specified in table 4.1. To support Wholesale- and the operator business, technically the Seller must offer MTU-size at 1534 on medium, premium och EA MEF. If inquired, there is a choice where MTU 1522 can be chosen for the Medium product for Buyers who require less frame size.

Pictures below show the connection from delivery to end customer, where traffic must be transported from one operator to another who sells capacity as a wholesale product. This Wholesale operator is transporting the service through a regional/national actor, e.g. clusters that finally terminate the connection through a city network.

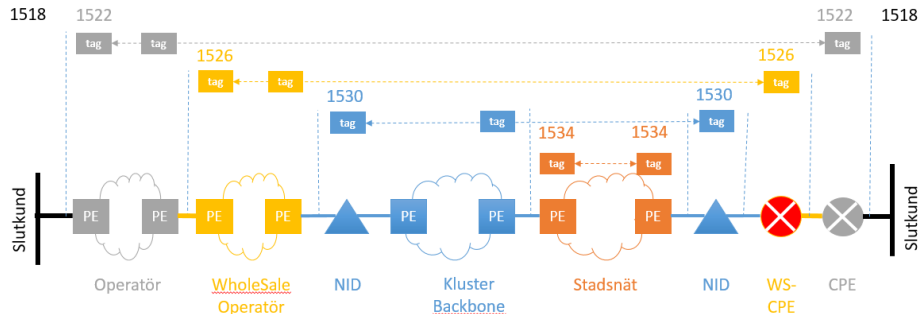
Table: MTU-sizes

Spec.	Ramstorlek	Kommentar
Ethernet MTU	1500 bytes	
Ethernet Standard	1518 bytes	8 bytes går åt till Standard
Ethernet VLAN med C-tag	1522 bytes	
Ethernet VLAN med C-, & S-tag	1526 bytes	Q-in-Q
Ethernet C,S och kluster-tag	1530 bytes	Stöd för nationell operatör
Ethernet C,S, kluster och carrier-tag	1534 bytes	Stöd för internationell operatör

Picture: E.g.: national operator business through clusters



Picture: E.g.: International operator business through national operator and clusters



1.5.3 REDUNDANCY

1.5.3.1 Physical redundancy

If redundant Ethernet Access is required, the following are applied (occasionally called protected access)

Redundant Ethernet Access must be based on Redundant Access according to the definition applied to the Service specification conditions of Dark fiber standard (reference)

1.5.3.2 Logical redundancy

If redundant Ethernet Access is required, logical redundancy is applied. This way two or several entries can be received at the delivery point, which logically means one entry that holds the same content.

1.5.4 OBLIGATIONS OF THE BUYER

The Buyer is responsible, and pays for the access to contracted Delivery points and for possible equipment needed for the implementation of the access plus possible CPE:s.

If the Buyer are to install equipment at the Buyer's property, the Buyer is responsible for the requirements in Access specification Site Access.

1.5.5 Test/measurement protocol

Test of service is done according the following levels:

- 1) Measurement based on Y.1564. Test is done on performance/traffic profile/ stability
- 2) Measurement based on MEF48, in principle Y.1564 plus tests for CoS and VLAN, Preservation, MTU-size, Multicast/broadcast frame delivery.
- 3) Measurement verifying "all" attributes according to specification.

Notice: *There is no standard specifying that the L2CP must be tested at delivery, but there are some potential problems to it. To show entirety presents credibility and a very good verification.*
Minimal measurement requirerments as follows. Document test deviations must be made. (E.g. capacity is measured 900Mbps on a 1000Mbps-link)

LEVEL OF MEASUREMENT	SERVICE
1	Ethernet Light
2	Ethernet Medium
3 alt. 2	Premium
3 alt. 2	Ethernet Access MEF

1.5.6 DEVIATION OF STANDARD COMPLIANCES

Standard compliances must be done according to technical functionality, read table 4.1 Overview of service specification Ethernet and optionable parameters, read 4.6. If there is anything not in line with the specification, it should be declared in the following table.

	Compliances	Yes	No	Comments
1.5.1	Functions			
1.5.1.1	Schema			
1.5.1.2	E-line EPL (according to MEF 6.2)			
1.5.1.3	E-line EVPL (according to MEF 6.2)			
1.5.1.4	Maintenance			
1.5.1.5	Ethertype			
1.5.1.6	Bandwidth			
1.5.1.7	CoS and DSCP-value			
1.5.1.8	L2CP			
1.5.1.9	VLAN			
1.5.1.10	Enduser Interface			
1.5.1.11	Delivery point Interface			
1.5.1.12	Ethernet OAM			
1.5.1.13	Multi- and broadcast			
1.5.2	Performance			
1.5.2.1	Available bandwidth			
1.5.2.2	Lost ethernet frames			
1.5.2.3	Delay			
1.5.2.4	Delay variation			
1.5.2.5	Order of ethernet frames			
1.5.5	Test/measurement protocol			
Other				

1.6 Options/Variables (for Ethernet products)

Following variables for Ethernet products is accessible for the buyer to order.

Options ETHERNET (variables)				
	Ethernet Light (1.2)	Ethernet Medium (1.3)	Ethernet Premium (1.4)	EA-MEF (1.5)
Access				
Microwave link (Not WiFi, Ethernet interface)		X	X	X
E-Line EPL (point to point port based) UNI-UNI (1.5.1.2)			X	X
E-Line EVPL (point to point VLAN based) UNI-UNI (1.5.1.3)			X	X
Point to Point (P-P)	X	X		
Point to multipoint (P-MP)	X	X		
Redundant access (4.5.3)		X	X	X
VLAN (CE-VLAN ID Preservation) (1.5.1.9)				
Alt 1 – No, a specified VLAN to UNI regardless of what is being sent (1.5.1.9)			Only EVPL	Only EVPL
Alt 2 – Yes, VLAN preservation end-to-end (1.5.1.9)			X	X

Alt1: No means that every site gets its own VLAN ID. Could be used for EVPL only.				
Alt2: VLAN ID is kept above the connection. At EPL-connection Alt2 is the only option.				
Management VLAN, read chapter 1.5.1.4				X
Enduser Interface (B-point)				
Bandwidth (Mbps) (UNI same as EVC bandwidth PIR, peak information rate) (1.5.2.1)				
10/10	X	X	X	X
20/20	X	X	X	X
30/30	X	X	X	X
40/40	X	X	X	X
50/50	X	X	X	X
60/60	X	X	X	X
70/70	X	X	X	X
80/80	X	X	X	X
90/90	X	X	X	X
100/100	X	X	X	X
200/200	X	X	X	X
250/250	X	X	X	X
300/300	X	X	X	X
400/400	X	X	X	X
500/500	X	X	X	X
600/600	X	X	X	X
1GB/1GB	X	X	X	X
10GB/10GB	X	X	X	X
40GB/40GB				X

100GB/100GB				X
Media contact (1.5.1.10)				
100Base-TX	X	X	X	X
100Base-FX		X	X	X
1000Base-T	X	X	X	X
1000Base-X (SFP-gate where end customer delivers/gets optional SFP)		X	X	X
1000Base-BX-U single Tx1310nm/Rx1550nm		X	X	X
1000Base-BX-D single Tx1550nm/Rx1310nm		X	X	X
10GBase-ER				X
10GBase-SR				X
10GBase-LR				X
40Gbase-LR4				X
40Gbase-FR				X
100Gbase-LR4				X
Interface to delivery point (A-point)				
Bandwidth (Mbps) (UNI same as EVC bandwidth PIR, peak information rate) (4.5.2.1)				
Delivery via NNI (VLAN must be stated)	X	X	X	X
10/10	X	X	X	X
20/20	X	X	X	X
30/30	X	X	X	X
40/40	X	X	X	X
50/50	X	X	X	X
60/60	X	X	X	X
70/70	X	X	X	X

80/80	X	X	X	X
90/90	X	X	X	X
100/100	X	X	X	X
200/200	X	X	X	X
250/250	X	X	X	X
300/300	X	X	X	X
400/400	X	X	X	X
500/500	X	X	X	X
600/600	X	X	X	X
1GB/1GB	X	X	X	X
10GB/10GB	X	X	X	X
40GB/40GB				X
100GB/100GB				X
Media contact (1.5.1.11)				
10Base- TX	X	X	X	X
10Base- FX	X	X	X	X
100Base-TX	X	X	X	X
100Base- FX	X	X	X	X
1000Base-T	X	X	X	X
1000Base-X (SFP-port where end customer gets optionable SFP)	X	X	X	X
10GBase-ER	X	X	X	X
10GBase-SR	X	X	X	X
10GBase-LR	X	X	X	X
40Gbase-LR4	X	X	X	X
40Gbase-FR	X	X	X	X

100Gbase-LR4	X	X	X	X
Service level				
SN 0 - 99.5% Holiday free weekdays	X	X	X	X
SN 1 - 99.7%		X	X	X
SN 2 - 99.9%		X	X	X
Option - On demand or continuous SLA measurement (additional service). Measurement of EVC with presentation through a portal. Real time/history		X	X	X
One-time fees/Contract period				
Connection fee (fixed fee for connection of point)	X	X	X	X
Digging cost (digging costs etc. for connection of point)	Node must be present	X	X	X
Contract period	X	X	X	X

1.7 Measurement period

Measurement period refers to a 12 months period and the period the Seller commits to perform Troubleshooting during service time according to agreed Service level for products specified in this service specification. Measurement period is used under Service level appendix.