

Access and Interconnection Agreement

Sub Annex E Technical Specification

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Access and Interconnection Agreement – Omantel – Ooredoo

Annex E _ Technical Specification

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1 General

1.1 This Sub Annex sets out the technical specifications of Omantel's Network.

2 Physical and Electrical Interface

2.1 Specifications at the Output STM-1 155 Mbit/S Optical interface (G.828 Compliant)

| Item | Description |
|--------------------------|---|
| Signal | S-1.1, 1310 nm according to ITU-T G.957 |
| Physical connectors | SC//FC/PC |
| Signal bit rate (kbit/s) | 155 520 |
| Maximal input jitter | EN 302 084 table 12 |
| Maximal output jitter | EN 302 084 table 1 |

| Item | Description |
|-----------------------------|-----------------------------|
| Bit rate | 155.52 Mb/s |
| Line code | Code Mark Inversion (CMI) |
| Pointer Adjustment | Based in G.828 ITU standard |
| Mask of the pulse | STM-1 |
| Maximum peak to peak jitter | 1.5UI p-p (UI=6.43ns) |

2.2 Specifications at the Output E1 traffic ports (G703 compliant)

| Item | Description |
|-----------------------------|----------------------------------|
| Bit rate | 2048 kbps +/- 50 ppm ITU-T G.703 |
| Line code | HDB3 ITU-T G 703 |
| Over voltage protection | refer to ITU-T K41 |
| Load Impedance | 75 ohms resistive ITU-T G.703 |
| Mask of the pulse | ITU-T G.703 |
| Maximum peak to peak jitter | refer to clause 2/ G.823 |

2.3 Specifications at the input E1 traffic ports (G.703 compliant)

2.3.1 The digital signal presented at the input port shall be as defined above but modified by the characteristic of the interconnecting pair. The attenuation of this pair shall be assumed to follow a \sqrt{f} law and the loss at a frequency of 1024 kHz shall be in the range 0 to 6 dB. This attenuation should take into account any losses incurred by the presence of a digital distribution frame between the equipment.

2.3.2 For the jitter to be tolerated at the input port, refer to clause 3/G.823. The return loss at the input port should have the following provisional minimum values:

| Frequency Range | Description |
|-----------------|-------------|
| 51 to 102 | 12 |
| 102 to 2048 | 18 |
| 2048 to 3072 | 14 |

2.4 Grounding of outer conductor or screen (G.703 compliant)

2.4.1 The outer conductor of the coaxial pair or the screen of the symmetrical pair shall be connected to the bonding network both at the input port and the output port.

2.4.1.1 NOTE 1 – The cable routing is important if leaving the system block. Consult Recommendation K.27 for guidance.

2.4.1.2 NOTE 2 – The direct connection of the outer conductors of co-axial cables to the bonding network at the transmit and receive interfaces may, because of differences in earth potential at each end of the cable, result in unwanted current flowing in the outer conductor, through connectors and through the receiver input circuitry. This may result in errors or even permanent damage. To prevent this problem, DC isolation may be introduced between the outer conductor and bonding network at the receive interface. The method of DC isolation must not compromise the EMC compliance of the equipment and the overall installation.

2.5 Over voltage and lightning protection on the E1 interfaces

2.5.1 The ITU-T recommendations K27, K35, K40 and K41 must be applied. Connection of Omantel’s E1 interfaces with the Requesting Party E1 interfaces using improper over

voltage and lightning protection measures are not allowed. Common earthing for both Omantel’s and the Requesting Part equipment with E1 interfaces is mandatory.

2.6 Jitter and wander on the E1 traffic interface

2.6.1 Network limits for Output Jitter at E1 traffic interface (ITU-T G.823 compliant)

| Interface | Measurement bandwidth, -3 dB frequencies (Hz) | Peak-to-peak amplitude(Ulpp) |
|--|---|------------------------------|
| 2048 kbit/s | 2048 kbit/s | 2048 kbit/s |
| | 2048 kbit/s | 2048 kbit/s |
| <p>NOTE 1</p> <p>For 2048 kbit/s interfaces within the network of an operator, the high-pass cut-off frequency may be specified to be 700 Hz (instead of 18 kHz). However, at interfaces between different operator networks, the values in the Table apply, unless involved parties agree otherwise.</p> <p>NOTE 2</p> <p>2048 kbit/s 1 UI = 488 ns</p> | | |

2.7 Network limits for Output Wander at E1 traffic interface (ITU-T G.823 compliant)

2.7.1 The maximum level of wander that may exist at a 2048 kbit/s network interface, expressed in MRTIE, shall not exceed the limit given in the next table:

| Observation Interval t (Sec) | MRTIE requirement (µs) |
|--|---------------------------|
| 0.05 < t <= 0.2 | 46 t |
| 0.2 < t <= 32 | 9 |
| 32 < t <= 64 | 0.28 t |
| 64 < t <= 1 000 (NOTE 1) | 18 |
| <p>NOTE 1 - For the asynchronous configuration the maximum observation interval to be considered is 80 seconds</p> | |

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2.7.2 Ethernet specifications

A firm feasibility check is required for each request. Below bandwidths can be provided:

- 1G and 10G (on a DWDM 10GE LAN & 10GE WAN interface)
- 100G (on a DWDM 100GE LAN & OTU4 interface)

2.7.3 Optical Specifications for 10Gbps Interfaces

| Speed | Interface |
|-------|--|
| 10G | 10G LAN PHY 10GBASE-LR, 10GE WAN PHY, OTU2, OTU2e |

2.7.4 Optical Specifications for 100Gbps Interfaces

| Interface Code | Laser Interface Type |
|----------------|-----------------------|
| 100GE & OTU4 | 100GBASE-LR4 - 1310nm |

3 Transmission

- 3.1 In order to ensure their compatibility with Omantel's transmission equipment and the observance of quality requirements under this Agreement, both Parties' transmission systems must meet the following relevant ITU-T recommendations:
- 3.1.1 ITU-T Recommendation G.703, Physical/electrical characteristics of hierarchical digital interfaces.
- 3.1.2 ITU-T Recommendation G.704, Synchronous frame structures
- 3.1.3 ITU-T Recommendation G.707, Network node interface for the synchronous digital hierarchy (SDH).
- 3.1.4 ITU-T Recommendation G.783, Characteristics of synchronous digital hierarchy (SDH) equipment functional blocks
- 3.1.5 ITU-T Recommendation G.784, Synchronous Digital Hierarchy (SDH) management
- 3.1.6 ITU-T Recommendation G.803, Architecture of transport networks based on the Synchronous Digital Hierarchy (SDH).
- 3.1.7 ITU-T Recommendation G.810, Definitions and terminology for synchronization networks.
- 3.1.8 ITU-T Recommendation G.811, Timing requirements of primary reference clocks.
- 3.1.9 ITU-T Recommendation G.812, Timing requirements of slave clocks suitable for use as node clocks in synchronization networks.
- 3.1.10 ITU-T Recommendation G.813, Timing characteristics of SDH equipment slave clocks (SEC).
- 3.1.11 ITU-T Recommendation G.821, Error performance of an international digital connection operating at a bit rate below the primary rate and forming part of an integrated services digital network

- 3.1.12 ITU-T Recommendation G.822, Controlled slip rate objectives on an international digital connection.
- 3.1.13 ITU-T Recommendation G.823, The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy
- 3.1.14 ITU-T Recommendation G.826, Error performance parameters and objectives for international, constant bit rate digital paths at or above the primary rate
- 3.1.15 ITU-T Recommendation G.841, Types and characteristics of SDH network protection architectures.
- 3.1.16 ITU-T Recommendation G.957, Optical interfaces for equipment and systems relating to synchronous digital hierarchy.
- 3.1.17 ITU-T Recommendation G.958 Digital line systems based on the synchronous digital hierarchy for use on optical fiber cables.
- 3.1.18 ITU-T Recommendation G.114 (1996), One-way transmission time
- 3.1.19 ITU-T Recommendation K.27, Bonding Configurations and Earthing inside a telecommunication building.
- 3.1.20 ITU-T Recommendation K.35, Bonding Configurations and Earthing At Remote Electronic Sites
- 3.1.21 ITU-T Recommendation K.40, Protection against LEMP in telecommunications centers
- 3.1.22 ITU-T Recommendation K.41, Resistibility of internal interfaces of telecommunication centres to surge over voltages.
- 3.1.23 ITU-T Recommendation M 2110 - Bringing-into-service of international PDH paths, sections and transmission systems and SDH paths and multiplex sections

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4 Synchronization

- 4.1 Both Parties' systems should be synchronized with Omantel's Network in the following manner:
- 4.1.1 According to the "master-slave" principle with Omantel as master, and according to ITU-T Recommendation G.812 from a long-term primary reference standard (Caesium standard) in accordance with ITU-T Recommendation G.811, with a long-term accuracy above 10⁻¹¹ and comply with ITU-T Recommendation G.823 on jitter and wander or from a GPS synchronization source meeting ITU-T specification G812.
- 4.2 Omantel shall provide a synchronization signal to operators in accordance with ITU-T Recommendation G.703. In normal conditions the 2.048 MHz signal will have a long-term stability above 10⁻¹¹. In case of faults in two independent synchronization paths, the accuracy may drop to hold-over mode but will be better than 4.6: 10

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5 SS7

- 5.1 Signaling system No.7 (SS7), complying with ITU-T and White Book ETSI Version2 standards will be used between both Parties' Networks.
- 5.2 At launch, signaling interconnection between both Parties will be in the associated mode whereby signaling channels and traffic channels share the same physical and logical path.
- 5.3 If Omantel subsequently introduces Stand Alone Signaling Transfer Points (SA-STPs) both Parties will meet to agree on the optimal signaling solution for interconnection between both Networks.

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6 SS7 Message Transfer Part

6.1 Message Transfer Part (“MTP”) is based on ITU-T Recommendation Q.701-Q.707 White Book 1993. Omantel specific implementation is based upon ITU-T Recommendations Q.702, Q.703 and Q.704

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7 SS7 ISDN User Part

- 7.1 The ISDN User Part (“ISUP”) is based on ITU-T Recommendation Q761-Q764 and Q850 White Book 1993 as well as ETSI ETS 300 356-1, 1995 (ETSI ISUP Ver. 2). The details of Omantel’s implementation and the supported procedures shall be made available by Omantel at the time of executing the agreement and if it is required.

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8 Short Message Service (SMS)

- 8.1 Both Parties will establish SMS interconnection through the SS7 signaling interconnection links between the Requesting Party and Omantel Network.
- 8.2 SMS routing from the Requesting Party to Omantel Network will be part of SS7 routing, which is based on load sharing towards Omantel's Network.

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9 SIP based Interconnection Services

- 9.1 SIP based interconnection services will be available after 1 year from the issuance of RAIO Review Decision.
- 9.2 Technical specifications of SIP-based interconnection services shall be developed by Omantel in coordination with the industry and appended to this section.

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10 The Requesting Party and his Customers' equipment

- 10.1 The type approvals of the end-customer equipment such as but not limited to customer premises equipment (CPE), modems, mobile handsets, computers and tablets is outside the scope of the responsibility of Omantel and shall be approved by the Authority.
- 10.2 The Requesting Party equipment such as but not limited to DSLAM, MSAN, Switch, IN Platform and Nodes shall be type approved by the Authority.
- 10.3 Omantel has the right to suspend any Service with immediate effect if the Requesting Party and/or its end-customers are in breach of the above.
- 10.4 The Requesting Party shall compensate Omantel for all costs incurred for rectifying faults, and errors and remedy damages due to the breach For the avoidance of doubt, this shall not include damages incurred by third parties.

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