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SERIES Q: SWITCHING AND SIGNALLING

Digital exchanges – Transmission characteristics

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## Transmission characteristics of digital exchanges

ITU-T Recommendation Q.551

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# **ITU-T Recommendation Q.551**

## **Transmission characteristics of digital exchanges**

### **Summary**

This Recommendation gives values for transmission characteristics related to the path from an exchange test point to an exchange interface and vice-versa. The overall characteristics for connections involving two interfaces can, in most cases, be obtained by suitably combining these values.

### **Source**

ITU-T Recommendation Q.551 was prepared by ITU-T Study Group 15 (2001-2004) and approved under the WTSA Resolution 1 procedure on 6 January 2002.

## FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

## NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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# ITU-T Recommendation Q.551

## Transmission characteristics of digital exchanges

### 1 Introduction

#### 1.1 General

The field of application of this Recommendation is found in ITU-T Rec. Q.500.

A high percentage of international calls will have a digital PABX included in the connection. Therefore, ITU-T Recs. Q.551-Q.554 are applicable also for digital PABXs with regard to those specific transmission parameters affecting the transmission quality of an international call, for instance, Loudness Ratings, noise, talker's and listener's sidetone, echo and stability. These Recommendations primarily concern digital PABXs connected digitally to the international network. However, network operators may find some of the specification details useful for digital PABXs connected by analogue means to the international network.

The signals taken into consideration are passed through the following interfaces as described in ITU-T Recs. Q.511 and Q.512 and Figures 1 and 2:

- Interface A is for primary digital signals at 2048 kbit/s or 1544 kbit/s.
- Interface B is for secondary digital signals at 8448 kbit/s or 6312 kbit/s.
- Interface C comprises both 4-wire and 2-wire analogue trunk interfaces. Interfaces C<sub>1</sub> 4-wire and C<sub>2</sub> 2-wire represent possible applications of interface C in Figure 1/Q.511.

Interface C<sub>1</sub> represents a 4-wire and interface C<sub>2</sub> a 2-wire analogue trunk interface. For practical reasons, C<sub>1</sub> and C<sub>2</sub> are further subdivided into C<sub>11</sub>, C<sub>12</sub>, C<sub>13</sub>, C<sub>21</sub> and C<sub>22</sub>.

C<sub>11</sub> interfaces channel translating equipment. C<sub>12</sub> and C<sub>13</sub> interface 4-wire analogue exchanges; C<sub>12</sub> via the relay sets, C<sub>13</sub> directly to the switching stages.

C<sub>21</sub> is an interface applicable when a 2-wire circuit connects a digital transit exchange with a local exchange, analogue or digital. C<sub>22</sub> is an interface applicable when a 2-wire circuit connects local exchanges, analogue and/or digital.

See Figures 1 and 2 for illustration of the principles.

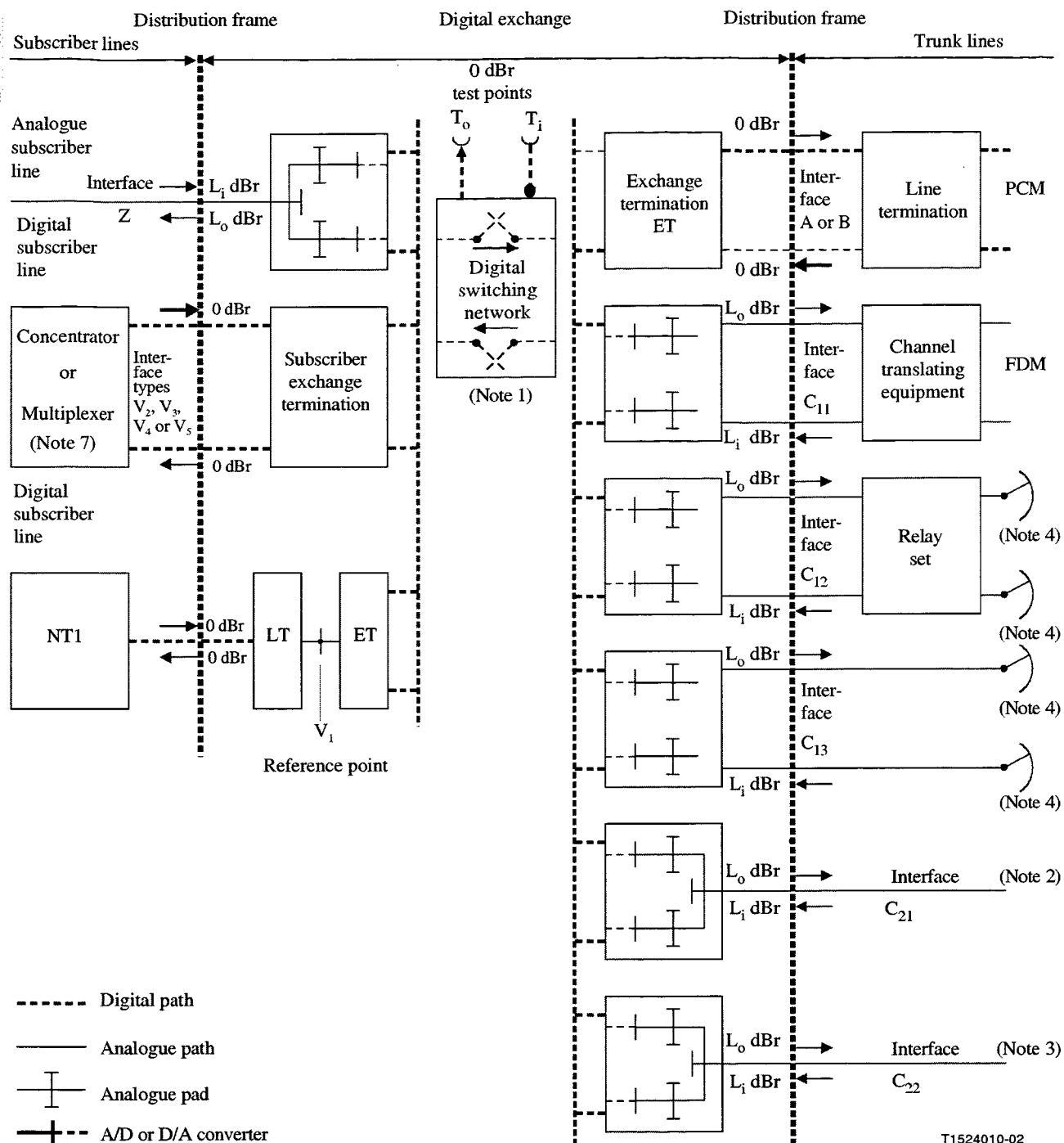
- Interface type V is for digital subscriber line access.
- Interface type Z is for analogue subscriber line access.

It should be noted that the ITU-T only recommends the C interfaces with certain reservations. The most important disadvantages, namely the reduction in flexibility and multiplicity, are mentioned in 4.1/Q.511.

NOTE 1 – Remote analogue exchange concentrators and analogue PABXs may use interface Z for access to a digital exchange.

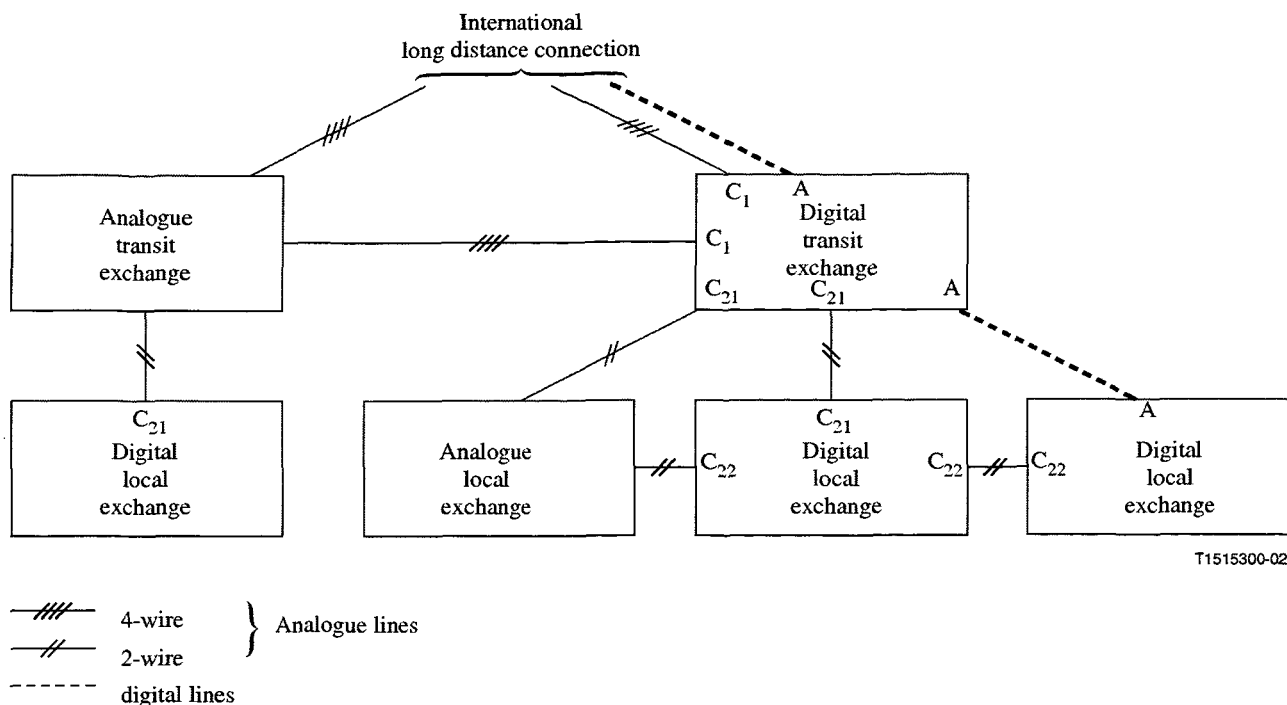
NOTE 2 – In the future, differences in circuit configurations with respect to transmission parameters may cause a subdivision of the Z interface.

Also, for interfaces other than those designated Z, there can exist types whose transmission characteristics have not been defined, even though they may be recognized as being in practical operation. This may be due to ITU-T not having considered their international standardization justified, e.g. because of their limited use, or because their function is to coordinate with pre-existing national standards. However, later additions to recommended interfaces are not ruled out (e.g. 4-wire subscriber interface).



- NOTE 1 – Digital loss pads, if required, may be located in the switching network or the exchange terminals (see 1.2.4.1).
- NOTE 2 – Termination of international long-distance switched connections (see Figure 2).
- NOTE 3 – Termination of local 2-wire trunk switched traffic (see Figure 2).
- NOTE 4 – Virtual international connecting point (see ITU-T Rec. G.101).
- NOTE 5 – This figure shows typical examples utilizing the defined interfaces.
- NOTE 6 – For different interfaces, the values of  $L_i$  and  $L_o$  are, in general, not equal.
- NOTE 7 – For details, refer to Figure 1/Q.512 and Figure 2/G.960.

**Figure 1/Q.551 – Interfaces, transmission levels and test points at a digital exchange**



**NOTE** – The trunks between local exchanges carry local traffic only.

**Figure 2/Q.551 – Interfaces in possible network interconnections**

Interface types V and Z may appear remote from the exchange through the use of digital transmission facilities. When this occurs, there should be no impact on transmission parameters other than delay. Transmission parameters associated with interface Z include the effects of the equipment provided for interfacing the analogue subscriber line to the digital switching network of the exchange.

It is necessary to ensure that representative DC currents are flowing during the measurements of all of these transmission parameters. These DC currents can contribute to noise, distortion, crosstalk, variation of gain with input level, etc. Therefore, appropriate allowances for this must be made. In some cases, where indicated, the permissible limits quoted include these allowances.

Detailed transmission characteristics for these interfaces are provided in the following Recommendations:

- ITU-T Rec. Q.552 for 2-wire analogue interfaces;
- ITU-T Rec. Q.553 for 4-wire analogue interfaces;
- ITU-T Rec. Q.554 for digital interfaces.

In the present Recommendations, values given for transmission characteristics relate to the path from an exchange test point to an exchange interface and vice versa; the overall characteristics for connections involving two interfaces can, in most cases, be obtained by suitably combining these values (see clause 3).

In the future, other interfaces may be defined.

These Recommendations consider analogue signals which are encoded in accordance with ITU-T Rec. G.711.

The transmission characteristics of voice-frequency (VF) connections through a digital transit exchange should in principle provide performance in accordance with ITU-T Rec. G.712 and, where applicable, ITU-T Rec. Q.45 *bis* (see also ITU-T Rec. G.142).

The principles of ITU-T Rec. G.142 and the limits of ITU-T Rec. G.712 have been used as a basis for establishing the transmission characteristics for analogue voice-frequency connections specified in 2/Q.552 and 3/Q.553. The limit values are not necessarily identical with those specified in the G-series, since in the case of a connection through the exchange, additional allowances generally have been made for cabling (see clause 2).

The values given are to be considered as either "design" or "performance objectives" according to the explanations of the terms given in ITU-T Rec. G.102 and the particular context.

The specification clauses in this Recommendation exclude the effects of auxiliary functions such as echo suppression, echo cancellation or transmission to the subscriber of metering impulses, or of non-telephony functions such as telemetering over the subscriber pair.

## 1.2 Definitions

### 1.2.1 Exchange test points, exchange input and output and half-connections

**1.2.1.1 exchange test points:** The exchange test points shown in Figure 1 are defined for specification purposes. They generally do not physically exist in an exchange but are accessed via the digital switching network. In this case, some or all of the switching network will be included in the path from the exchange interface to the access points.

The transmission parameters affected by this means of access are the absolute group delay and possibly jitter and wander and bit error ratio. For most other parameters, either the exchange test points or the access points are located such that end-to-end performance can be determined by suitably combining performances between each interface and either the exchange test points or the access points.

**1.2.1.2 exchange input and output:** The exchange input and output for a connection through a digital exchange are located at the interfaces identified in 1.1 and shown in Figures 1 and 2.

The exact position of each of these points depends on national practice, and it is not necessary for the ITU-T to define it.

However, the applicability of recommended values to points arbitrarily located is subject to certain restrictions:

- for analogue interfaces, as referred to in clause 2 (maximum length of exchange cabling between exchange equipment ports and the interface);  
The term equipment port in this Recommendation is defined as a functional unit (e.g. connector) of the equipment through which signals can enter or leave the unit under test. Requirements for measurements made at an equipment port do not include an allowance for wiring to a distribution frame.
- for digital interfaces, as also mentioned in clause 2 (maximum loss between exchange interfaces and connected equipment, e.g. digital line or higher order multiplex equipment).

NOTE – Transmission planning of the network is based on the characteristics presented to each other by the exchange and transport networks across the interfaces constituting the boundaries of responsibility between these respective functions – see Figure 1/Q.511. Whereas these points are accessible for a network in overall operation, they will not exist for acceptance testing of exchange equipment before installation, which must therefore use the equipment ports. While in many cases the difference caused by exchange cabling may be negligible, this is not always the case. The choice of exchange cabling and the possible need for compensating its effects should therefore be born in mind.

### 1.2.1.3 Half-connections

**1.2.1.3.1 input connection:** A unidirectional path from an interface of a digital exchange to an exchange test point.

**1.2.1.3.2 output connection:** A unidirectional path from an exchange test point to an interface of a digital exchange.

**1.2.1.3.3 half-connection:** A bi-directional path comprised of an input connection and an output connection, both having the same exchange interface.

NOTE 1 – These terms may be qualified by the words "analogue" or "digital", the qualification signifying the property of the exchange interface.

NOTE 2 – An analogue input (output) (half) connection may be further qualified by the words "2-wire" or "4-wire".

**1.2.2 relative levels:** The relative level designations in the Q.550-series Recommendations refer to the power handling capacity of the half-connections. When the half-connections are considered as elements of a circuit in a transmission plan, the associated relative level designations may be given other values. See ITU-T Recs. G.100.1 and G.101.

### **1.2.2.1 Exchange test points**

The nominal relative level at the input and output exchange test points is assigned the value 0 dBr.

### **1.2.2.2 Analogue interfaces**

The nominal relative level at the exchange input point is designated  $L_i$ .

The nominal relative level at the exchange output point is designated  $L_o$ .

### **1.2.2.3 Digital interfaces**

The relative level to be associated with a point in a digital path carrying a digital bit stream generated by a coder lined-up in accordance with the principles of ITU-T Rec. G.101 is determined by the value of the digital loss or gain between the output of the coder and the point considered.

If there is no such loss or gain, the relative levels at the exchange input and output points (i.e. digital interfaces V, A and B) are by convention said to be 0 dBr. For further information, see ITU-T Rec. G.100.1.

NOTE – The digital level may be established using measuring equipment in accordance with ITU-T Rec. O.133.

Relative level has no meaning for digital bit streams that are not derived from real or simulated analogue sources.

## **1.2.3 Measurement conditions**

### **1.2.3.1 Common measurement conditions**

All digital signal-processing devices which affect bit integrity of the 64 kbit/s path (e.g. digital loss pads, code converters, digital echo control devices, digital speech interpolation apparatus or all-zero-suppressors) must be rendered inoperative when measuring the transmission parameters of this Recommendation. However, if the nominal transmission loss, NL, for speech connections is implemented by a digital loss pad, the loss pad must not be inoperative when measuring parameters dependent on NL.

Where measuring transmission parameters between 2-wire ports is considered necessary, the opposite direction of transmission must be interrupted in order to avoid disturbing effects due to reflections at hybrids.

In addition, a quiet code, i.e. a PCM signal corresponding to decoder output value 0 ( $\mu$ -law) or output value 1 (A-law), with the sign bit in a fixed state, should be applied to the exchange test point.

NOTE – These patterns are slightly different from the idle code produced by an exchange (see e.g. 2.12/Q.522).