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Information technology – Customer premises cabling – Planning and installation guide to support ISO/IEC 8802-5 token ring stations

*Technologie de l'information –
Câblage des locaux de clients – Guide de planification
et d'installation pour les stations en anneau à jetons
de l'ISO/CEI 8802-5*



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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by their respective organizations to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC1.

ISO/IEC 12075, which is a technical report of type 3, has been prepared by ISO/IEC Joint Technical Committee JTC 1/SC 25.

The main task of technical committees is to prepare International Standards. In exceptional circumstances a technical committee may propose the publication of a technical report of one of the following types:

- type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;
- type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;
- type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art" for example).

Technical reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

In many cases, information in this technical report is subject to change. The working group expects to re-issue and update this report on a periodic basis to supply the international community with the latest information on evolving standardization activities.

Information technology - Customer premises cabling

Planning and installation guide to support ISO/IEC 8802-5 token ring stations

1 Scope

The purpose of this technical report is to supplement the token ring standard ISO/IEC 8802-5, and the annex "Information technology - Local and metropolitan area networks - Token ring access method and physical layer specification - Recommended practice for use of unshielded twisted pair cable (UTP) for token ring data transmission at 4 Mbps." with information relating to suitable transmission media and installation guidance, without placing undue constraint on implementers regarding detailed sizing and configuration. The recommendations and topologies outlined here draw on and are complementary to the ISO/IEC generic cabling Standard, 11801, under development at the approval of this guide.

This report therefore includes the following:

- a description and recommended values of characteristics of the appropriate elements within a token ring network;
- the cabling system topology with recommended distances;
- transmission requirements of suitable medium for 4 and 16 Mbit/s token rings;
- guidelines for the design, planning and installation of cabling systems to support 4 and 16 Mbit/s token rings;
- guidance on documentation and labelling to support token rings.

The procedure to check the suitability of installed cabling to support 4 or 16 Mbit/s token rings is a topic for future study.

This technical report addresses the use of both shielded and unshielded lobe cabling. Unless otherwise noted within the text, all cabling recommendations specifically refer to using 150 Ω shielded twisted pair lobe cabling.

When ISO 8802-5 is reissued this report should be updated to realign with both that guide and the Generic wiring standard.

1.1 Normative references

The following normative documents contain provisions which, through reference in the text, constitute provisions of this technical report. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this technical report are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 96-1: 1986, Radio-frequency cables-Part 1: General requirements and measuring methods.

IEC 603-7: 1990, Connectors for frequencies below 3 MHz for use with printed boards - Part 7: Detail specification for connectors, 8-way, included fixed and free connectors with common mating features.

ISO/IEC 8802-5: 1992, Information processing systems - Local and metropolitan area networks - Part 5: Token ring access method and physical layer specifications.

ISO/IEC 11801: General cabling standard (under consideration)

2 Definitions and abbreviations

BD **Building Distributor:** The combination of functional elements (e.g. patch panels, multiplexers). Used to connect between the building and campus cables.

Balanced cable: A cable consisting of one or more symmetrical cable elements. Construction of conductors belonging to a transmission circuit are identical and twisted together using a certain lay.

Back-up path: Spare transmission path in trunk cabling, normally used for signal transmission only when there is a failure on the main ring path.

Bridge: MAC sublayer interconnector of rings.

Cabling: The collection of all cables, connectors, patch panels and other passive components which compromise the telecommunication infrastructure.

Cable: An assembly of one or more cable elements contained within a common sheath or tube.

Cable element: A number of insulated conductors or optical fibres. Examples of cable elements are: pair, shielded pair, quad, shielded quad.

CD **Campus Distributor:** Premises main distributor

Channel: Data path from any transmitting station's Medium Interface Connector (MIC) to the next downstream receiver's MIC, including possibly, its own. (Also referred to as Transmission Path)

Concentrator: A device which provides the function of multiple Trunk Coupling Units (TCUs). Token ring concentrators interface to the main transmission path with two ports, ring-in and ring-out. Data Terminal Equipment (DTEs) are attached to the concentrators' lobe attachment ports via lobe cabling.

Converter: Special type of repeater which converts signals using different media types.

Distributor: See Telecommunication Closet.

Drive Distance: The maximum distance a signal can propagate along a channel from transmitter to receiver, and still be within specification. Drive distance is a function of line losses and component losses such as those from connectors and TCUs. Line losses can be characterized as losses with a square root of frequency characteristic, and component losses can be characterized as having a fixed component plus a square root of frequency component.

DTE **Data Terminal Equipment:** Any device which attaches to the LAN and communicates via the LAN protocols on that LAN.

DTE attachment cable: A short flexible cable (generally less than 3 meters), connecting the DTE to the MIC.

Equivalent station count: Complex devices and links which contain more than a single retiming circuit must be characterised by the number of retiming circuits they contain. This count is called "Equivalent Station Count".

HD **Horizontal Distributor:** The telecommunication distributor which houses the termination for the horizontal cabling.

Horizontal cabling: The horizontal cabling subsystem extends from a floor distributor to the telecommunications closet outlet(s) connected to it. The subsystem includes the horizontal cables, the mechanical termination of horizontal cables at the floor distributor, the cross connections at the floor distributor and the telecommunications closet outlets.

Hybrid cable: A cable consisting of a combination of two or more cable elements of different characteristic.

IEEE **Institute of Electrical and Electronics Engineers**

IEC **International Electrotechnical Commission**

ISO **International Organisation for Standardisation**

LAN **Local Area Network**

Link: A section of the token ring transmission path, without station attachments, bounded by repeaters or converters. A link is characterized by its latency and associated accumulated jitter. At its input and output it must be able to receive any valid receive level signal, and must transmit signals conformant with the transmit specifications at a MIC. The link may or may not use proprietary signalling within it. Neither transmission parameters nor signal coding are defined for the link.

Lobe cabling: The cabling used to interconnect the MICs to the TCUs. This cabling includes all horizontal cabling, patch cables and possible work area cabling between TO and MIC. The lobe cable only carries signals when the station attached to the lobe is active on the ring.

LLC **Logical Link Control**

Main ring path: Primary transmission path in the trunk cabling. The Main Ring Path carries the data in the primary direction. (Contrast with Back-up path)

Medium: The cabling on which the message may be transmitted.

MAC **Medium Access Control:** The portion of the terminal that controls and mediates the access to the ring.

MIC **Medium Interface Connector:** The connector situated between the terminal and trunk coupling unit (TCU) at which all transmitted and received signals are specified. It is one of the connectors of the mated pair at the measurement reference point. Typically, the DTE attachment cable is connected to the wall outlet, and this connection point is the MIC. Otherwise, the MIC is generally at the data connector end of the attachment cable. Other physically identical connectors used elsewhere in the system are not referred to in this guide as MIC connectors.

NEXT **Near End Cross Talk**

Pair: A cable element which consist of two insulated conductors forming a transmission line circuit.

Patch cables: Short flexible cables required to connect fixed cabling and active and passive components in a telecommunications closet.

Patch panel: Termination point for building cabling in a telecommunications closet. Attachment of that cabling to repeaters and concentrators is typically done with short sections of cable called patch cables.

PHY Physical Layer

Repeater: Physical layer interconnector of rings. Provides for physical containment of the channels, dividing the ring into segments. A repeater can receive any valid token ring signal and retransmit it with the same characteristics and voltage levels as a transmitting station.

Router: Network layer interconnector of LANs (rings, buses, etc.)

Ring in: The port of an element that receives signal from the main ring path on the trunk cable, and provides connectivity to the ring out port of the immediate upstream element.

Ring out: The port of an element that transmits the output signal to the main ring path on the trunk cable, and provides connectivity to the Ring In port of the immediate downstream element.

Ring segment: Section of transmission path bounded by repeaters or converters. Ring segment boundaries are critical for determining the transmission limits that apply to the devices within the segment, because no transmission channels cross the ring segment boundaries.

Shielded cable: An assembly of one ore more cable elements wrapped by an overall static shield contained within a common sheath or tube.

Shielded pair: A cable element which compromises two insulated conductors forming a transmission line circuit and twisted together covered by a static shield.

Shielded star quad: A cable element which compromises four insulated conductors twisted together, two diametrically facing conductors forming a transmission line circuit and over which is applied a static shield.

STP Shielded Twisted Pair cable: Shielded twisted pair cable is normally used to mean shielded twisted pair cables or shielded quad cables independent of their characteristic impedance. However, when used in this guide the expression refers specially to those shielded twisted pair or shielded quad cables with a high frequency characteristic impedance of $150\ \Omega \pm 15\ \Omega$. In addition to having an overall shield, the individual pairs may be shielded.

Star quad: A star quad consists of four conductors twisted together for the length of the cable. Opposite conductors must be used as a pair.

TO Telecommunications Outlet: A connecting point, in a fixed position, where the horizontal cabling terminates. The telecommunication outlet provides the interface to the work area cabling.

Trunk cable: The transmission medium for interconnection of concentrators and TCUs providing a main signal path and a back-up signal path, exclusive of the lobe cabling.

- TCU** **Trunk Coupling Unit:** A physical means that enables a station to connect to a trunk cable. The trunk coupling unit contains the means for inserting the station into the ring or, conversely, bypassing the station.
- TC** **Telecommunications Closet (distributor):** The space provided in a building where the horizontal and backbone cabling terminates. The Telecommunication Closet houses the TCUs, concentrators, repeaters etc. in addition to housing the equipment associated with the telecommunication wiring system. The Telecommunications Closet is sometime referred to as a Distributor.

Trunk path: That portion of the transmission path which always carries signals independent of which stations are active on the ring and which are not.

- UTP** **Unshielded twisted pair:** UTP normally refers to unshielded twisted pair cables or star quad cables independent of their characteristic impedance. However, when used in this guide, UTP or unshielded twisted pair refers specifically to those unshielded twisted pair cables or star quad cables which meet the specifications of 100 Ω Category 3 UTP. Shielded cables meeting the 100 Ω Category 3 specifications are included with in this definition.

Work area cabling: Additional cabling required to go from the outlet to the DTE attachment cable when the DTE is not placed near the outlet.

3 Topology in principle

3.1 System overview

The token ring network is a physical star connected to a logical ring that accommodates (allows for) the connection of up to 250 attaching devices (processors, printers controllers, repeaters, converters etc.) per ring through specially designed adapters installed in the attaching devices. The ring is established by connecting all attaching devices to Trunk Coupling Units (TCUs) using the transmission media described in clause 5. During operation the TCUs will establish a logical ring of all active attached devices and will bypass all inactive attached devices. The attaching device interfaces with the adapter to use the ring for sending and receiving data. The ring is used as follows:

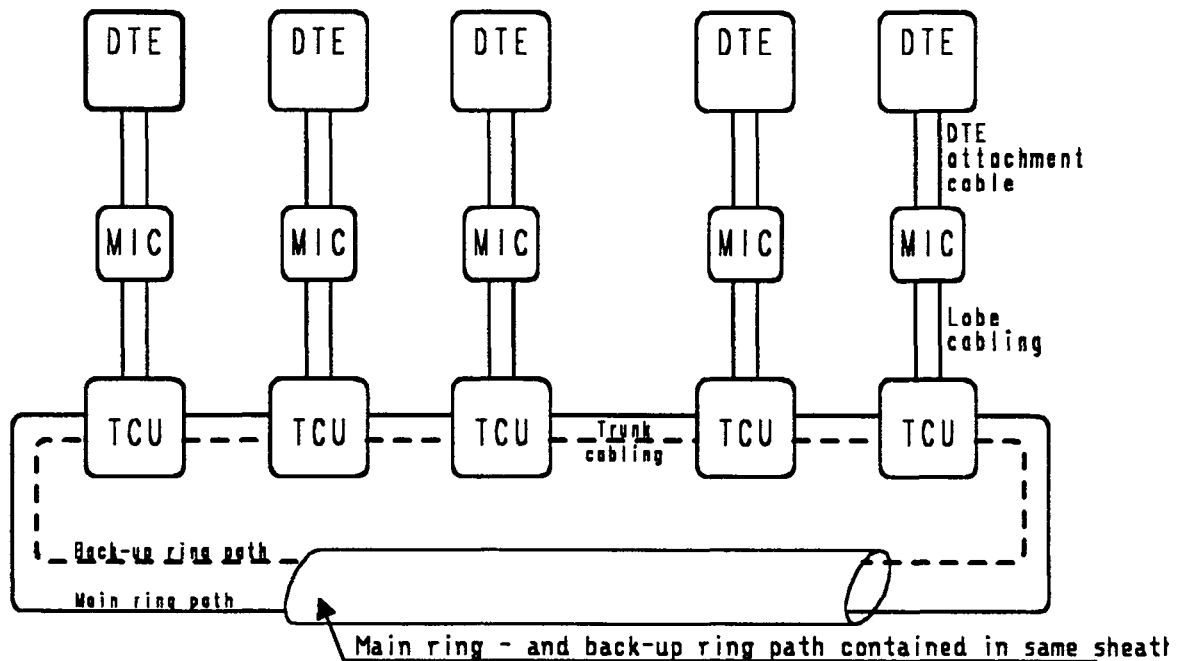
The attaching device notifies the adapter that it has a message to send. Upon receipt of a token, the adapter appends the message, together with both the sender's and the recipient's addresses on the token circulating around the ring. The token then becomes a frame.

The token ring network is a baseband system. Messages are transmitted and received at a rate of either 4 or 16 Megabits per second (Mbit/s). The data rate at which a single ring operates is determined by the data rate of the adapters in the attaching devices. All attaching devices on a single ring must have adapters that operate at the same data rate. All normal network operations are performed without user intervention once the message has been directed to the adapter. The operator of the attaching device does not have to be aware of routing and protocol procedures.

This report focuses on the guidelines for establishing single rings. It is possible to create a network that consists of individual rings interconnected with bridges or routers. With such a configuration, messages are passed from an attached device on one ring through a bridge or routed to an attached device on another ring. For a short discussion of design considerations with bridges see 3.3.

3.2 Basic topology

The basic topology for token-ring networks as defined by ISO 8802-5 is a set of trunk coupling units (TCUs) connected together in a ring via trunk cabling as shown in figure 1. All discussions of token ring topology dealt with location of the ring components and are independent of their state, i.e. the configuration is independent of which devices are active at any particular time.



NOTE: Trunk-, lobe- and DTE cables contain two data-paths.

Figure 1 - Basic topology for token ring circuits

The cabling interconnecting TCUs is defined as the trunk cabling. Connected to each TCU is lobe cabling which terminates in a Medium Interface Connector (MIC).

Typically, the lobe cabling consists of the following:

- a patch cable from the TCU to the horizontal cabling.
- the horizontal cabling from the telecommunications closet to the telecommunications outlet.
- any work area cabling from the outlet to the DTE's MIC.

The TCU has two states, the insert state and the bypass state. In the bypass state, the TCU directly routes the incoming signal port to the trunk cable to the outgoing signal on the trunk cable. When a DTE is actively participating in the ring, the incoming signal from the trunk cable is routed to the DTE's receiver via a first signal path of the lobe cable. The DTE then transmits via a second signal path in the lobe cabling to the outgoing signal path on the trunk cable (see figure 2).

Connected to each MIC is a DTE. In actual implementation, horizontal cabling normally runs from the work area to centralised telecommunication closets. The TCUs may be built singly or combined; as multi-TCU concentrators.