

IEEE Std 802.5c-1991
(Supplement to IEEE Std 802.5-1989)

IEEE Standards for
Local and Metropolitan Area Networks:
**Supplement to Token Ring Access Method and
Physical Layer Specifications**

**Recommended Practice for Dual Ring
Operation with Wrapback Reconfiguration**

Sponsor
**Technical Committee on Computer Communications
of the
IEEE Computer Society**

Approved March 21, 1991

IEEE Standards Board

Abstract: Extensions to the IEEE 802.5 Token-Passing Ring standard are defined. These extensions implement a Dual Ring local area network (LAN) topology that provides full interoperability between stations conforming to IEEE Std 802.5, including coexistence on the same ring, and recovery from all single media failures with full capability restored. The Dual Ring topology and operation described are intended for applications that require very high availability and recovery from media and station failures.

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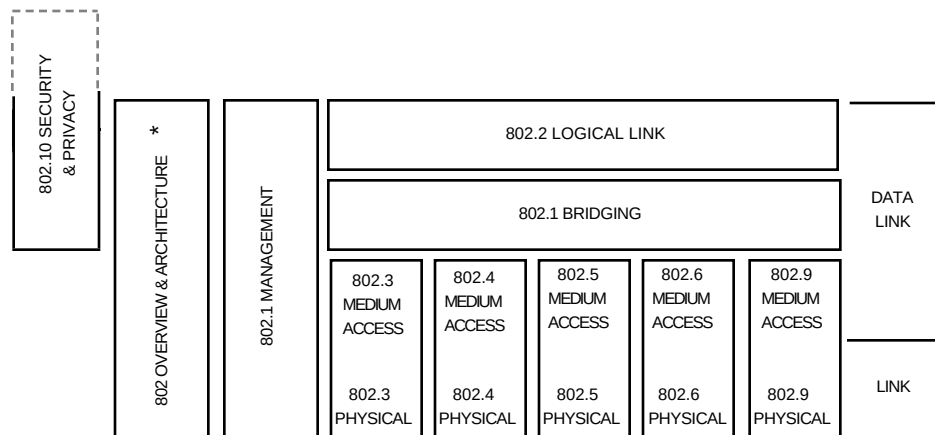
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Foreword

(This Foreword is not a part of IEEE Std 802.5c-1991, Recommended Practice for Dual Ring Operation with Wrapback Reconfiguration.)

This standard is part of a family of standards for local and metropolitan area networks. The relationship between the standard and other members of the family is shown below. (The numbers in the figure refer to IEEE Standard numbers.)



* Formerly IEEE Std 802.1A.

This family of standards deals with the physical and data link layers as defined by the ISO Open Systems Interconnection Basic Reference Model (ISO 7498:1984). The access standards define several types of medium access technologies and associated physical media, each appropriate for particular applications or system objectives. Other types are under investigation.

The standards defining these technologies are as follows:

- IEEE Std 802[†] : Overview and Architecture. This standard provides an overview to the family of IEEE 802 Standards. It is a part of the 802.1 scope of work.
- IEEE Std 802.1D: MAC Bridging. Specifies an architecture and protocol for the interconnection of IEEE 802 LANs below the MAC service boundary.

[†] The 802 Architecture and Overview Specification, originally known as IEEE Std 802.1A, has been renumbered as IEEE Std 802. This has been done to accommodate recognition of the base standard in a family of standards. References to IEEE Std 802.1A should be considered as references to IEEE Std 802.

- IEEE Std 802.1E: System Load Protocol. Specifies a set of services and protocol for those aspects of management concerned with the loading of systems on IEEE 802 LANs.
- ISO 8802-2 [ANSI/IEEE Std 802.2]: Logical Link Control.
- ISO/IEC 8802-3 [ANSI/IEEE Std 802.3]: CSMA/CD Access Method and Physical Layer Specifications.
- ISO/IEC 8802-4 [ANSI/IEEE Std 802.4]: Token Bus Access Method and Physical Layer Specifications.
- IEEE Std 802.5: Token Ring Access Method and Physical Layer Specifications.
- IEEE Std 802.6: Metropolitan Area Network Access Method and Physical Layer Specifications.

In addition to the family of standards are technical advisory groups as follows:

- IEEE Std 802.7: Broadband Technical Advisory and Physical Layer Topics and Recommended Practices.
- P802.8: Fiber Optic Technical Advisory and Physical Layer Topics.

The reader of this document is urged to become familiar with the complete family of standards.

This standard contains state-of-the-art material. The area covered by this standard is undergoing evolution. Revisions are anticipated to this standard within the next few years to clarify existing material, to correct possible errors, and to incorporate new related material. Information on the current revision status of this standard may be obtained by contacting

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IEEE Standards for
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**Supplement to Token Ring Access Method and
Physical Layer Specifications**

**Recommended Practice for Dual Ring
Operation with Wrapback Reconfiguration**

1. Overview

This document defines extensions to IEEE Std 802.5, IEEE Standards for Local and Metropolitan Area Networks: Token Ring Access Method and Physical Layer Specifications, which implements a Dual Ring LAN topology having the following features:

- (1) Full interoperability between stations conforming to IEEE Std 802.5, including coexistence on the same ring.
- (2) Recovery from all single media failures with full capability restored.

1.1 Introduction. The Dual Ring topology and operation described within this document is intended for applications that require very high availability and recovery from media and station failures.

The Dual Ring topology is illustrated in Fig 1-1. Two individual (counter-rotating) Token-Passing Rings provide the interconnection for both Dual Ring and Single Ring stations. Counter-rotating rings are defined where the upstream neighbor of a station on one ring is the downstream neighbor of that station on the other ring. One of the Token-Passing Rings is designated as the Primary Ring and the other is designated as the Secondary Ring.

The Primary Ring is normally the operational ring. When the Primary Ring is operational, no data other than Medium Access Control (MAC) frames can flow on the Secondary Ring. Also, recovery requiring reconfiguration is not initiated for a failure on the Secondary Ring if the Primary Ring is operational.

Single Ring stations can only be connected to the Primary Ring through a Trunk Coupling Unit (TCU) and operate exactly as specified in IEEE Std 802.5.

Dual Ring stations are connected to their neighboring Dual Ring stations on both the Primary and Secondary Rings through two TCUs. Generally, each Dual Ring station contains two complete IEEE Std 802.5 interfaces and a Crosspoint Switching function controlled by a Dual Ring Management function.

Dual Ring reconfiguration employs “Wrapback” to provide for recovery from all forms of signal loss failures and from trunk line media failures

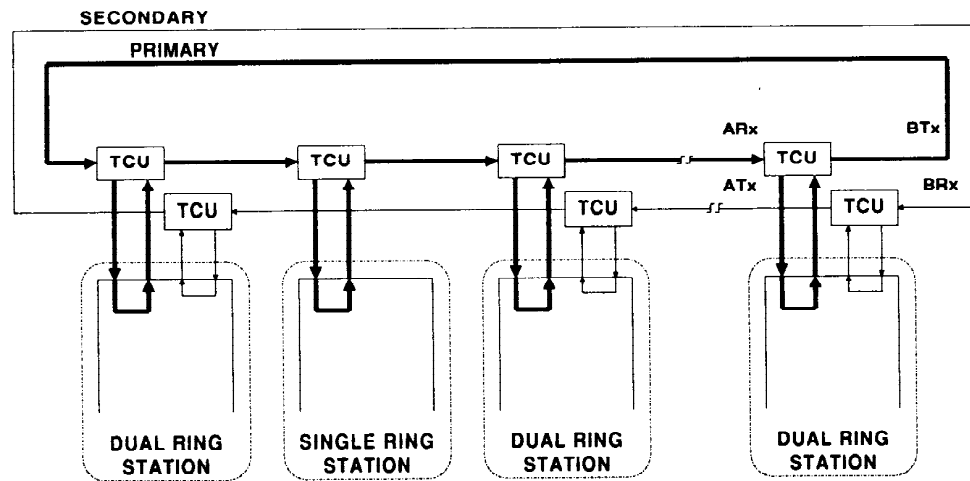


Fig 1-1
Dual Ring Architecture

not covered by IEEE Std 802.5-1989. (These failures are referred to as “Break Conditions” in this document.) The secondary MAC never transmits LLC frames in any of the Dual Ring configurations; thus, extensions such as bridging are not affected by Dual Ring operation. The Wrapback method restores normal operation by interconnecting the two rings on each side of the failure (see Fig 1-2). This results in a single ring being formed from the remaining good parts of the original two rings (but with the failed link, or node, absent). A reconfigured ring is comprised of the following:

- (1) One station in WRAPA (Primary Receive (ARx) connected to the Secondary Transmit (ATx)).
- (2) One station in WRAPB (Secondary Receive (BRx) connected to the Primary Transmit (BTx)).
- (3) The remaining intervening stations in Normal (Primary and Secondary Receive (ARx, BRx) connected to the Primary and Secondary Transmit (BTx, ATx), respectively).

1.2 Definitions. The following definitions, in addition to those contained in IEEE Std 802.5, are used in this recommended practice:

Beacon Reconfigure (BNR). A beacon (Type 1) used in the reconfiguration protocols.

Break Indication. The state where the Physical Layer (PHY) is unable to recover data from the incoming signal, or the incoming signal power level is less than a defined threshold.

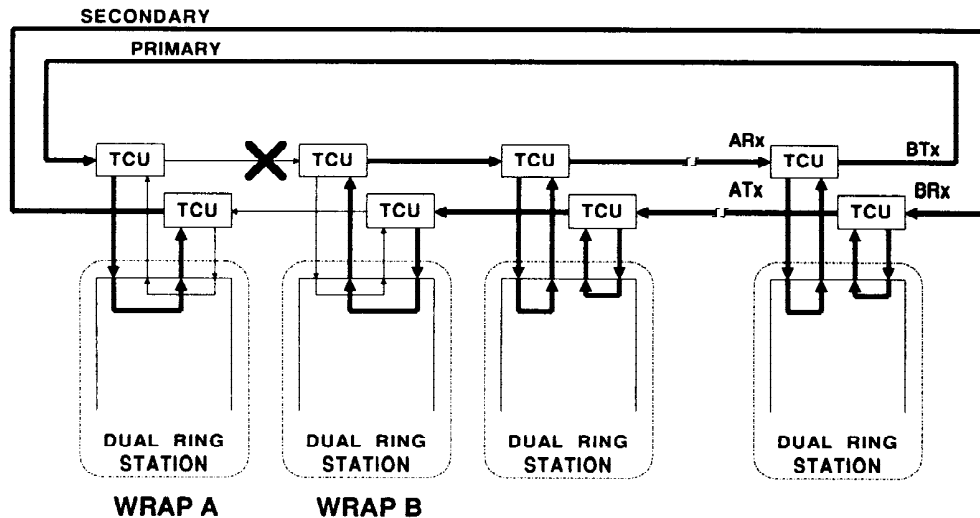


Fig 1-2
Failure Recovery by Wrapback

Crosspoint Switch. A switching function that provides normal connections, wrap connections, breaks in the transmit, and local loopback for lobe testing in the wrap mode.

Dual Ring. A topology (such as that shown in Fig 1-1) in which stations are linked by link pairs and, from any one station to another, there are exactly two distinct paths, where a path is defined as a sequence of consecutive links in which no link pair is traversed more than once.

Dual Ring Management. The management functions of a Dual Ring station responsible for Dual Ring reconfiguration.

Dual Ring station. A station that attaches link pairs that have opposite directions of data flow with respect to the adjacent Dual Ring stations. It consists of two MACs, a crosspoint function, and Dual Ring Management. It may have other attachments.

link. A unidirectional physical and media connection between two stations.

link pair. A pair of links going in opposite directions between two stations.

merging. Reconfiguration function that involves Dual Ring stations ceasing to use contra-rotating links in favor of a restored link or station.

Primary Ring. In a Dual Ring, this is the ring over which application data (LLC frames) are exchanged during normal operation. MAC1, which transmits the application data, is attached to the Primary Ring. When a Dual

Ring station is in either WRAPA or WRAPB, MAC1 is switched to remain in the operational section of the wrapped ring. The Primary Ring uses the links ARx and BTx in each Dual Ring station.

reconfiguration. A change of the path around which the token that is used for normal data transfer circulates.

Reconfiguration Management. The management functions responsible for reconfiguration. This includes both Dual Ring Management and any other management required for reconfiguration.

Secondary Ring. The alternate paths of the Dual Ring that are not normally connected to MAC1. It uses links BRx and ATx. Application data may be transmitted on this ring, but not when the Primary Ring is being used for transmitting application data.

Single Ring station. A station that offers one attachment to the network on the Primary Ring.

Wrapping. Reconfiguration function that involves Dual Ring stations using contra-rotating links to avoid a failed link or node.

1.3 Abbreviations and Symbols. The following abbreviations and symbols, in addition to those contained in IEEE Std 802.5, are used in this recommended practice. The underlined x indicates that the x shall be replaced by the appropriate numerical value:

AMP _x	MAC(1 or 2) generated Active Monitor Present signal
BCN	Any beacon (Type 1, 2, 3, or 4)
BNN	Beacon Normal (Type 2, 3, or 4)
BNR	Beacon Reconfigure (Type 1)
DRCF	Dual Ring Crosspoint function
DRFSM	Dual Ring Finite State Machine
D _x	Dual Ring Finite State Machine state
FSM	Finite State Machine
MAC _x I	MAC(1 or 2) generated insert signal
MBF _x	MAC Break Flag (MAC1 or 2)
MIF	Management Interlock Flag
MPF	Merge Permission Flag
RBNN _x	MAC(1 or 2) Receive Beacon Normal
RBNR _x	MAC(1 or 2) Receive Beacon Reconfigure
RBPWRS	Repeat BNRs on Primary and wait for reconfiguration to stabilize
TBNN _x	MAC(1 or 2) generated Transmit Beacon Normal
TBNR _x	MAC(1 or 2) generated Transmit Beacon Reconfigure
TCLT _x	MAC(1 or 2) generated Transmit Claim Token
TBF _x	MAC Transmit BNR Enable Flag
TB _x	TCU Bypass Insert signal, Primary (1) and Secondary (2)
TD _x	Timer, Dual Ring, State D _x

Time_TD _x	Time interval for Timer, Dual Ring, State D _x
TPWBNR	Transmit BNR on Primary and wait for BNR
TSWBNR	Transmit BNR on Secondary and wait for BNR
XA	Break, Primary Ring receive
XB	Break, Secondary Ring receive

