Chapter 2

The Token Ring

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Abstract

Architecture, performance, transmission system, and wiring strategy of a token-ring local-area network implemented at the IBM Zurich Research Laboratory are described. In the design of the system, particular emphasis was placed on high reliability, availability, and serviceability. To ensure robustness of the token-access protocol, we employ the concept of a monitor function which is responsible for fast recovery from access-related errors. Our protocol supports asynchronous transmission of data frames concurrently with full-duplex synchronous channels, e.g., for voice services or other applications requiring guaranteed delay. The delay-throughput performance of the token ring is shown to depend very little on data rate and distance. The transmission system of the ring is fully bit synchronous and allows insertion/removal of stations in/from the ring at any time. A mixed ring/star wiring strategy is used which provides the means for both fault detection and isolation, and system reconfiguration, and allows systematic wiring of a building.
1. INTRODUCTION

Local communication systems for data employing various topologies have been used for a long time [Kuemmerle 82], [Cyper 78]. The current activities in the field of local-area communication networks can be viewed as an expansion to data networks to make high-speed packet-switching services available to the in-house domain. There are three driving forces. First, progress made in VLSI technology to implement low-cost network adapters; second, the availability of high-speed transmission media at reasonable cost, and third, the trend to distributed processing with intelligent workstations. The following objectives are to be achieved:

- To provide the basic communication functions for various types of devices, such as terminals, workstations, printers, communication controllers, host computers, etc.

- To solve the problem of crowded cable ducts, to allow easy system expansion, and to stop the proliferation of transmission systems for different sets of products.

- To allow manufacturers the design of compatible network components through standardizing media, transmission system, and access-control procedures.

This paper describes the major aspects pertaining to architecture, wiring, transmission, and performance of a local-area ring system with token-passing access designed and implemented at the IBM Zurich Research Laboratory [Meyr 80], [Bux 81a], [Bux 81b], [Bux 82], [Mueller 82], [Rudin 82], [Meyr 82], [Keller 83]. One of the first accounts of the basic token-access mechanism was presented by Farmer and Newhall [Farmer 63]; some other references are [Farber 73], [Penney 79], [Clark 78], [Saltzer 80]. Our contributions focus on system reliability, availability and serviceability. In particular, our investigations demonstrate that a local-area network based on a token ring has the following attractive features:

1) robustness and efficiency of the access protocol, i.e., quick recovery from token errors and excellent delay-throughput characteristic compared with other access-control schemes employed on bus and/or ring systems;

2) physical reliability and the potential for systematic wiring through the concept of wiring concentrators to which stations are connected in a radial fashion and which are interconnected by the main ring cable;

3) electrical stability of a ring consisting of a chain of several hundred repeaters, and