The purpose of this short introduction is to provide background for a discussion of an application-oriented multiprocessing system.

An application-oriented multiprocessing system

I Introduction

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To meet the challenges posed by today's aircraft and rising volumes of air traffic, the Federal Aviation Administration (FAA) is undertaking a many-faceted developmental program for increasing the capabilities of its traffic control system. Referred to as the National Airspace System (NAS), the program is evolutionary in the sense that the projected goals are to be reached systematically through step-by-step changes. The system deals, on an unusually large scale, with all of the basic functions normally associated with real-time control: information gathering, data communication, data processing, man-machine interaction, and information dissemination. Contributing to the system as a whole are many FAA-defined subsystems; the devices and programs that implement these subsystems are provided by a variety of contractors.

A prime objective of the NAS Air Traffic Control subsystem is to increase system safety and efficiency through the application of automation techniques. In order to make this possible, the FAA has postulated exceptionally stringent requirements for continuity in machine operations. One of the FAA's problems has been to find a reasonably economical way of assuring twenty-four hours a day, fail-safe computing-center operations. To this end, the FAA specified a need for a general-purpose, modular multiprocessing computer system that could be controlled by a single supervisor program. The design selected by the FAA was the IBM 9020 multiprocessing system, a system made up of SYSTEM/360 units modified to assure the specified system availability.

The properties of a 9020 configuration that distinguish it from a standard SYSTEM/360 installation are (1) additional capabilities in the equipment elements, (2) a control program with a heavy design emphasis on efficient control of multiple processing units, (3) a program for dynamic fault analysis and, whenever necessary, for dynamic system reconfiguration and (4) an auxiliary supervisor program for calling library routines and controlling them in the course of test and maintenance activities.

It deserves emphasis that the multiprocessing system under discussion is application-oriented in the sense that many of its functional capabilities are designed to meet explicit requirements. It would be another matter to formulate such capabilities for a general-purpose environment.

The next four sections (Parts II to V) of this paper are meant to provide a structural grasp of the 9020 equipment and the three functional programs that complement the equipment in operation. Part II discusses equipment, emphasizing the 9020 capabilities that do not appear in the standard SYSTEM/360. Part III discusses the control program that governs operational activities in an equipment subsystem assigned to the NAS application. When this control program encounters equipment faults, it turns for immediate aid to the error-analysis program described in Part IV; this program is responsible for identifying malfunctioning elements. Once an element is determined to be malfunctioning, it is taken out of the application subsystem and assigned to a maintenance subsystem. Diagnostic programs in the maintenance subsystem are executed under control of the special monitor discussed in Part V.

The functional implementations covered in Parts II to V constitute an operable 9020 multiprocessing system with high-availability capabilities. Part VI is included to bring the reader back to the fact that 9020 installations are only nodes in the huge NAS real-time network. Functions of the five main application programs, as well as the main features of the input/output environment, are discussed.