The Development of Micro-BUSMAN: Scheduling on Micro-Computers

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Early versions of the BUSMAN system have been described at previous workshops. BUSMAN consists of the TASC and VAMPIRES bus scheduling components (BUSPLAN) and the COMPACS and IMPACS crew scheduling or run cutting components (CREWPLAN). Since 1984, BUSPLAN and CREWPLAN have been adapted for IBM-PC compatible micro-computers; the opportunity has been taken to make the system much more user-friendly, and to rationalise the interaction between the complementary sub-systems. This paper first introduces BUSMAN, then describes the philosophy of the Micro-BUSMAN system. Input mechanisms are outlined, and an assessment is made of the relative suitabilities of the TASC and VAMPIRES algorithms. The COMPACS crew scheduling system, which has not been presented in full elsewhere, is outlined, and its integration with IMPACS described. The transfer of the algorithms from mainframes to micros is briefly discussed, and the mode of using the whole Micro-BUSMAN suite is presented. The extent to which the system is currently being used is outlined.

1 Introduction

The VAMPIRES bus scheduling program has its origins in railway locomotive scheduling work over the period 1960-1965 (Wolfenden and Wren (7)), and was adapted to bus scheduling in 1970 (Wren (8)). Throughout the 1970s continual improvements were made, and the definitive version of the stand-alone program is given by Smith and Wren (4). VAMPIRES is based on a powerful heuristic which seeks out all opportunities of dead running and identifies changes which would have to be made to trip timings if a solution is to be achieved with a particular number of buses.

VAMPIRES is particularly powerful where services are irregular and opportunities can be taken of inter-lining and dead running. During the 1970s and early 1980s, VAMPIRES was used by consultants on behalf of about twenty clients; in each case, savings of at least five percent of vehicles numbers were shown, and in several cases savings were in excess of ten percent.

The TASC program was written for situations where there was relatively little need for dead running; it was designed to assist the scheduler to generate timetables and schedules quickly from basic information on route patterns and service times and intervals. TASC has been described by Hartley and Wren (1), and has since had a wide range of additional features added. TASC was the first scheduling program incorporated in the BUSMAN suite (Williamson (6)). VAMPIRES has since been
added to BUSMAN in the manner proposed by Hartley and Wren, to form the BUSPLAN module, available on PRIME mini-computers.

In BUSPLAN, schedules for individual routes or groups of related routes are formed in one or more TASC runs, and are amended interactively if appropriate. The TASC schedule blocks are then scanned for possible inefficiencies, i.e., unduly long layovers or positioning journeys (dead or on service). The schedules are then un-linked at these events and divided into smaller blocks. Such blocks from several different schedule runs are presented to VAMPIRES as if each block were a separate trip, and VAMPIRES seeks a better way of re-linking them, ensuring that the TASC links are reinstated unless a positive advantage is gained by changing them. In this way, the apparently time-consuming process of VAMPIRES is applied to amalgams of trips rather than to individual trips. Finally, the optimised VAMPIRES schedule is passed back to TASC for any further interactive amendment, and for document production.

An early form of the IMPACS crew scheduling program was presented at the previous workshop by Wren, Smith and Miller (6); its basic form is more fully described by Smith and Wren (5). In a parallel paper to this, Wren and Smith (10) discuss problems arising in the implementation of IMPACS. IMPACS is part of the CREWPLAN module of BUSMAN, and as such has been available for some time on PRIME mini-computers; it is available independently on IBM main-frames.

While IMPACS is an automatic system based on mathematical programming, COMPACS, which was outlined in the paper by Wren, Smith and Miller, and is described in Section 4.1 of the current paper, is an interactive system guided by heuristics. COMPACS and IMPACS can be used together within CREWPLAN, or either may be used alone. When they are used together, COMPACS becomes a tool for specifying any particularly desired duties before IMPACS is used to form the schedule automatically, and for adjusting interactively the schedule produced by IMPACS.

Section 2 of this paper sets out the rationale behind the development of Micro-BUSMAN. In Section 3, we explain how the best features of TASC and VAMPIRES have been combined in Micro-BUSPLAN. In Section 4, after describing COMPACS, we describe Micro-CREWPLAN, in which IMPACS and COMPACS complement each other. Section 5 explains how information flows through the system, and Section 6 outlines current use.

2 Micro-BUSMAN

The advantages of micro-computers for scheduling are many, and will not be enumerated here. It is worth noting, however, that in the United Kingdom at least, a major advantage is that purchase and control of the equipment rests in the hands of the user; the city’s treasurer can no longer dictate what programs are to be run on his main-frame, and the prejudices of in-house computer staff can be circumvented.

Outline planning of Micro-BUSMAN began in 1982. The first eighteen months of the project were financed partly through a grant from the British Government’s Science and Engineering Research Council; this was approved in the autumn of 1983, and work commenced in January 1984. The