Chapter 4.0 System Requirements For A Real-Time System

4.1 Considerations for Development of a System Architecture for a Real-Time System

System Architecture may be defined as "*a stable basis for a working and workable system*" (Blonk and Giezen, 1994). In this case, the system under consideration is the real-time advanced warning and traffic control system. By "*working,*" the definition means that the system must fulfill its primary objectives of reducing work zone delays, congestion, and accidents, and providing motorists and potential travelers with meaningful, real-time information on traffic status in order to assist them in making intelligent decisions on travel plans for safer and time-efficient travel. The workability of the system refers to the quality aspects of the system. Workability requirements include system user-friendliness, maintainability, flexibility, and safety. Under no circumstances should the system malfunction, providing incorrect information leading to an incident or dangerous situation for motorists. Therefore, the basis for the system, which includes communication links, sensors, computers, softwares, and output devices, needs to be stable. "*Stable*" means that the basis for the system needs to be defined in such a manner so that no major changes are necessary for any upgrades or changes in the future. This means that the system should be in compliance with different technology protocols of its subsystems, and should have the ability to extend its capabilities and be open to upgrades.

There are two types of system architecture, namely, the logical architecture and the physical architecture. The logical architecture refers to a model that shows the various components of the system, the communication links between them, and their interface with the users. The physical architecture, on the other hand, is a specific selected solution for actual implementation. It gives details such as number of sensors, number of output devices to be employed, and type of hardware and software to be used. In this chapter we will be referring mostly to the logical architecture for the real-time advanced warning and traffic control system.

The real-time advanced warning and traffic control system consists of several subsystems or subarchitectures that are integrated together to form the system. The subsystems work together in gathering traffic data, analyzing it, and, based on the analysis, providing appropriate real-time information to the motorists. These subsystems include: (1) traffic sensors or data collection devices, (2) roadside central computer, (3) information dissemination devices, (4) traffic control center, and (5) communication links. Some of these subsystems such as the traffic control center and different types of dissemination tools may be optional. Figure 8 shows a typical architecture for the system.

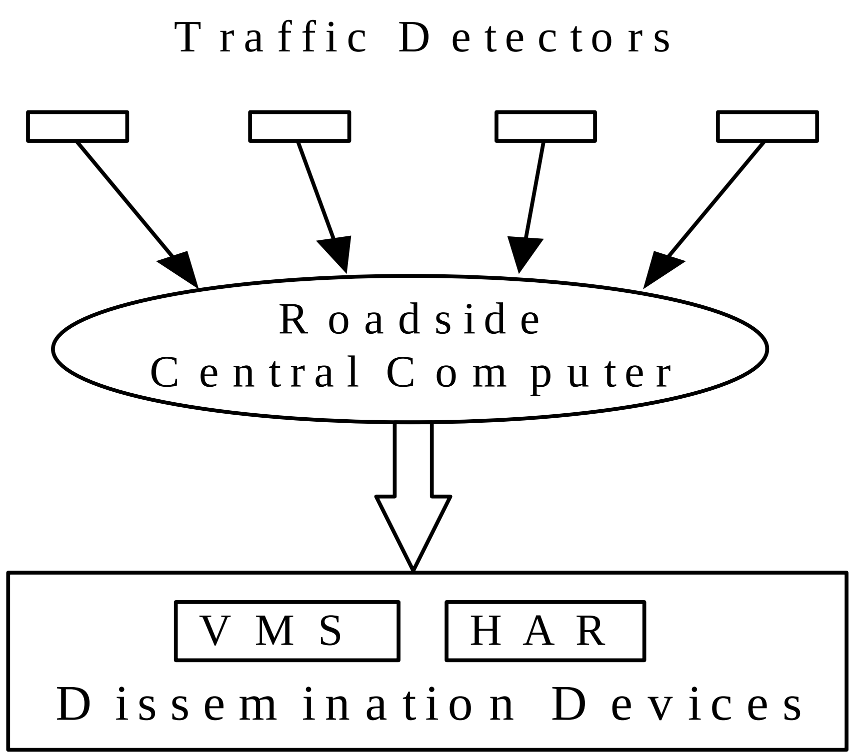

Figure 8. Typical system architecture for a real-time advanced warning and traffic control system

The system works as follows. The traffic sensors/data collection devices spaced out along the length, upstream and downstream of the work zone, gather information on traffic flow variables such as speed and occupancy. This raw data is relayed to the roadside central computer via a suitable communication link. The roadside central computer analyzes the raw data and develops meaningful inferences from the information. Based on the inferences drawn, the roadside central computer makes intelligent decisions regarding the status of traffic within the work zone. Alternatively, the inferences drawn by the roadside central computer may be sent to a traffic control center, where decisions regarding the status of traffic within the work zone may be made. In either case, in the event of deteriorating traffic conditions within the work zone, the roadside central computer sends out appropriate advanced warning and advisory messages to the motorists using the information dissemination/output devices. If a traffic control center is involved in the loop, it may instruct the roadside central computer on the messages to be disseminated to the motorists. Additionally, if an emergency such as a fire or fatal accident is detected, appropriate emergency services such as the police, ambulances, clearance teams, and fire squads are notified. All subsystems within the system are connected via suitable communication links for information exchange. Figure 9 shows a typical system architecture for a real-time advanced warning and traffic control system.

Following is a brief discussion of the issues to be considered when deciding on the physical architecture of the system:

- Traffic Sensors/Data Collection Devices: The system being developed for work zone purposes dictates that the traffic sensors be of the non-pavement intrusive type. Thus, the sensors employed should either be overhead-mounted or sidefired. Depending on the flow variables of interest, physical characteristics, and detection characteristics such as number of lanes, power requirements, range, and cost considerations a suitable type of sensor may be employed.