The Hanshin Expressway was the first urban toll expressway in Osaka, Japan. Although in 1964 its length was only 2.3 kilometers, today it is a large highway network of 200 kilometers. The expressway serves the Hanshin (Osaka-Kobe) area, which is the second most populated region in Japan. An average of 828,000 vehicles use the expressway each day, and sometimes the number is in excess of 1,000,000. In 1970, the Hanshin Expressway Public Corporation started to implement an automated traffic control system in order to maximize the number of vehicles flowing through the network.

The system relies on two control methods: (1) limiting the number of cars that enter the expressway at each entrance ramp and (2) providing drivers with up-to-date traffic information on, among others, expected travel times and accidents. The application of the first approach depends on whether the expressway is in a normal, steady state of operation or if any unusual events such as accidents or breakdowns have occurred.

In the steady-state case, the Hanshin system employs the technique of <u>linear programming</u> to determine the highest traffic volume of the expressway, while preventing congestion and other adverse effects on the surrounding road networks. The data that drives the LP model is collected from the detectors installed every 500 meters along the expressway and at all entrance and exit ramps. Every five minutes the real-time information gathered from the detectors is used to update the model coefficients and a new linear program is formulated to compute the maximum number of automobiles the expressway can accommodate.

The automated traffic control device has been very successful. According to several surveys, it has helped decrease the length of congested portions of the highway system by 30% and the duration by 20%. The system is extremely cost-effective, and drivers consider it an indispensable service.

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[*] Adapted from Yoshino, T., Sasaki, T., & Hasegawa, T. The traffic-control system on the Hanshin Expressway. *Interfaces*, 1995, January-February, 94-108.