

	<p>The Iris Company 923 E. 39th St. Austin, TX 78751 512-452-2448 512-452-8950 fax esiris@aol.com</p>	<p>This is a press release prepared for Texas Instruments for international electronic distribution (June 1996). —Emily Sopensky</p>
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China's Foshan City Automates Toll Collection with Texas Instruments TIRIS™ Systems

China's booming population and go-go economy are stretching the capacity of existing infrastructures, especially bridges and highways. The evidence that increased commerce requires increased mobility is quite apparent when driving on existing highways in and around Foshan: Trucks, cars, motorcycles, bicycles, and even people vie for the use of the same roadways. And the many bridges in the city act as traffic bottlenecks.

Foshan City Chooses Texas Instruments TIRIS AVI Systems

To impose some sanity as well as increase vehicular throughput on well-used toll roads, Foshan city officials opted for installation of Texas Instruments TIRIS™ automatic vehicle identification (AVI) systems for electronic toll collection (ETC). Since February 1996, 23 ETC systems have been installed by TIRIS and partners MFS Network Technologies, the systems integrator.

E.Z. Tech (U.S.) International Ltd., an American-based international engineering firm, evaluated six systems for the Foshan Tongda Advanced Technical and Industry Co. and for Foshan officials. The 915 MHz radio frequency identification (RFID) AVI system was chosen only after extensive field testing with 3,000 subscribers. According to E.Z. Tech Marketing Manager John Tang, "Four of the six RFID systems simply had too many problems to warrant setting them up for even a trial period. Of the remaining two, the system from TIRIS and MFS Network Technologies was by far the best solution for providing reliable, dependable reads."

E.Z. Tech and city authorities chose the 900 spectrum range because of costs and concerns about spectrum allocation associated with higher ranges.

Toll Collection in China

Roads in China, primarily the responsibility of local jurisdictions, depend on funding for construction and maintenance from local investors and foreign corporations. Toll collection is the source of most return on investment in China for new road construction and some maintenance. Not surprisingly, the three banks that issue the vehicle tags for automatic toll collection in the Foshan area are also major investors in the Foshan project. Except for the new AVI systems, tolls in China are collected manually, since coins—and therefore automatic coin machines—are not used in China.

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A major city in the densely populated southern province of Guangdong, Foshan is in the heart of the famed Pearl River Delta, and just a short boatride from Hong Kong. A few of the Foshan AVI system sites are actually in the neighboring cities of Nan Hai and Shunde.

The success of the Foshan AVI systems is apparent from the stepped up installation of them. While 18 systems were originally planned for installation in the Foshan area, 23 systems have already been installed with another 17 planned for the remainder of 1997. In addition to the existing 5,000 subscribers with installed vehicle transponder tags, an additional 20,000 transponders already have been ordered.

Successful Installations Despite the Odds

In the Foshan area, the potential for cross-reads and double reads is high. Traffic on existing tollroads is beyond capacity, with much of it competing for space at the toll booths. The ETC systems, installed in existing toll lanes, have a very narrow read area. At several sites, systems had to be hung beneath canopies that deflect and bounce RFID signals. Towers for transmitting cellular phone calls are relatively close, making them a potential source of signal interference.

Installation is complicated by the fact that the heavily traveled roadways and bridges cannot be closed even to test the installations. Early in the project, officials reluctantly shut down one road for two hours to test the system. Traffic quickly backed up three kilometers for several hours. After that incident, the authorities decreed that the system could no longer be shut down—not even for installation.

The systems also must endure constantly high temperatures and humidity. MFS lead technician Bill DiMartino explained, “My partner, senior engineer Derwin Bell, and I come from New Jersey where the weather is quite temperate. Until we had to work in the heat and humidity that is common to Foshan, we had no idea how taxing the environment could be on both people and systems alike.”

How It Works

The TIRIS-based ETC systems use RFID transponders and antennas to identify vehicles and collect tolls. The transponders, programmed with data that includes a unique ID, are installed in each vehicle and read by an overhead antenna from a range of 20 or more feet. Because vehicles can be read in less than half a millisecond with an accuracy rate of 99.95 at 150 mph, this high frequency RFID application makes it ideal for the non-stop congested traffic flow characteristic of Foshan toll roads.

The toll charge is automatically deducted as the vehicle passes under the TIRIS antenna. The read/write transponders are reprogrammable so that a subscriber’s account can be adjusted with new deposits. The system uses a simple traffic light to inform travelers of their account status: green for a healthy account balance, yellow for an account with a low balance, and red for a negative balance. If the traveler receives the red light signal, he will be stopped at the toll plaza. Currently, video cameras are not yet part of the enforcement system.

More Projects in China

China is just one of many countries that has long been faced with the problems of crowded highways. The country is experiencing a phenomenal 15% annual increase in the number of

vehicles. Many roads are already overwhelmed with the existing 1.8 billion vehicles estimated to be in China. The highway infrastructure, including its 2700 toll roads, is one of China's biggest problems.

Two of the biggest industrial cities in China are Guangzhou in the Quandong (or Canton) Province and Shanghai. Two systems were recently installed in Shanghai and are currently undergoing extensive testing and evaluation. Three thousand transponders have already been issued.

During the first quarter of 1997, another two demo systems are being installed in Guangzhou city. These systems will be similar to those installed in California's SR91 automated toll collection highway. Unlike the Foshan and Shanghai projects, this trial will enable tolls to be collected on an open highway from vehicles traveling at high speed. The Guangzhou systems will use an overhead light curtain to scan high-speed vehicle profiles for classification purposes.

With the installation of these and other TIRIS-MFS Network Technologies systems, China has a firm grip on improving its highway infrastructure to allow its booming economy unheeded access to the marketplace.

For more information, please contact, Erin McGuire, MFS Network Technologies, 1200 Landmark Center, Suite 1300, Omaha, Nebraska, 68102-1841, voice: (402) 233-7648 fax: (402) 233-7650 email: mcguire.erin@mfst.com.

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Note: TIRIS (Texas Instruments Registration and Identification System) is an advanced radio frequency ID technology that includes both passive, low frequency transponders, active, high frequency transponders, reader equipment and software. Applications, include automotive antitheft systems, vehicle identification, security access, and automatic logistics management, and electronic toll collection systems.

More than 120,000 AVI transponders are already in use on MFS Network Technologies-equipped roadways throughout the U.S. on thoroughfares ranging from Boston's Third Harbor Tunnel to California's 91 Express Lanes and the Foothill, San Joaquin Hills and Eastern Transportation Corridors. MFS Network Technologies is a leader in the intelligent highway industry--working with state and federal agencies in the United States and internationally to use technology to help solve today's growing transportation problems. As highways across the country become more congested, MFS Network Technologies offers technology-based solutions to allow more efficient use of new and existing facilities. Across the United States, the Company is actively involved in major transportation projects in Arizona, California, Colorado, Delaware, Florida, Massachusetts, New Jersey, New York, and South Carolina. The company's objective is to establish its intelligent transportation systems as the standard across the country.

MFS Network Technologies is a leader in the development, design and integration of intelligent infrastructure solutions for advanced communications and intelligent transportation applications. The company's clients include federal, state and local government agencies, telecommunications services companies, regional and state transportation and transit agencies, public utilities and private industry in the U.S. and abroad.