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US

Tolling and Managed Lane Solution in Texas.
The LBJ Express and North Tarrant Express.


always one step ahead

Three projects that are part of major highway improvements in the Dallas-Fort Worth Metroplex.

Kapsch TrafficCom North America was selected to design, install, and implement the field systems as a key piece of a fully integrated managed lanes system for three projects in the Dallas-Fort Worth Metroplex. The field systems provided by Kapsch include the Toll Collection System (TCS), an Advanced Traffic Management System (ATMS), Intelligent Transportation System (ITS) and a fully redundant Network Communication System (NCS) used to manage all toll and traffic operations in real-time.

The field systems are highly integrated into the central systems that include the Back Office System (BOS) which performs transaction processing, the Toll Setting Module (TSM) which determines toll rates, DriveOn which allows for virtual HOV declaration and Data Warehouse / Business Intelligence DW/BI which provides a unified reporting system across field systems and central systems platforms. It was critical that both field and central systems worked seamlessly together to ensure smooth and effective operations of the business and of the corridor.

TSM
BOS
DriveOn
DW/BI
ATMS
TCS
NCS
ITS
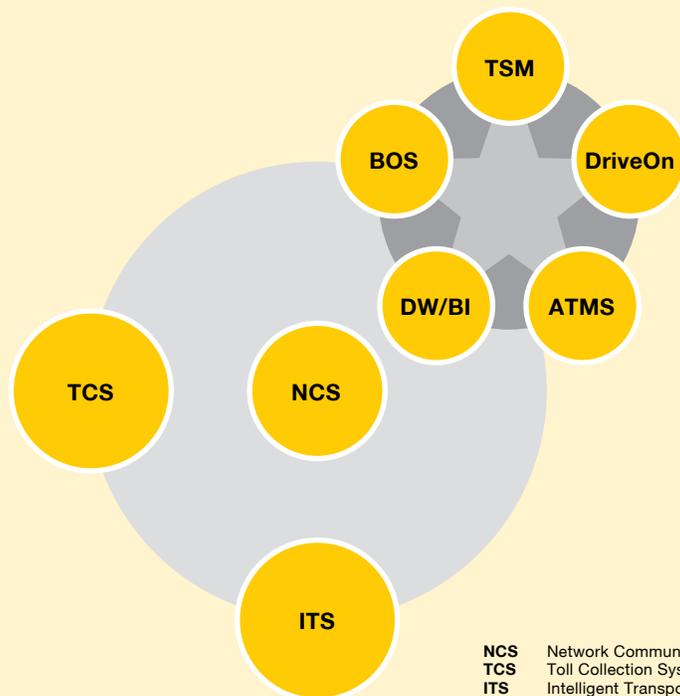
NCS	Network Communication System
TCS	Toll Collection System
ITS	Intelligent Transport System
TSM	Toll Setting Module
ATMS	Advanced Traffic Management System
DW/BI	Data Warehouse / Business Intelligence
BOS	Back Office System
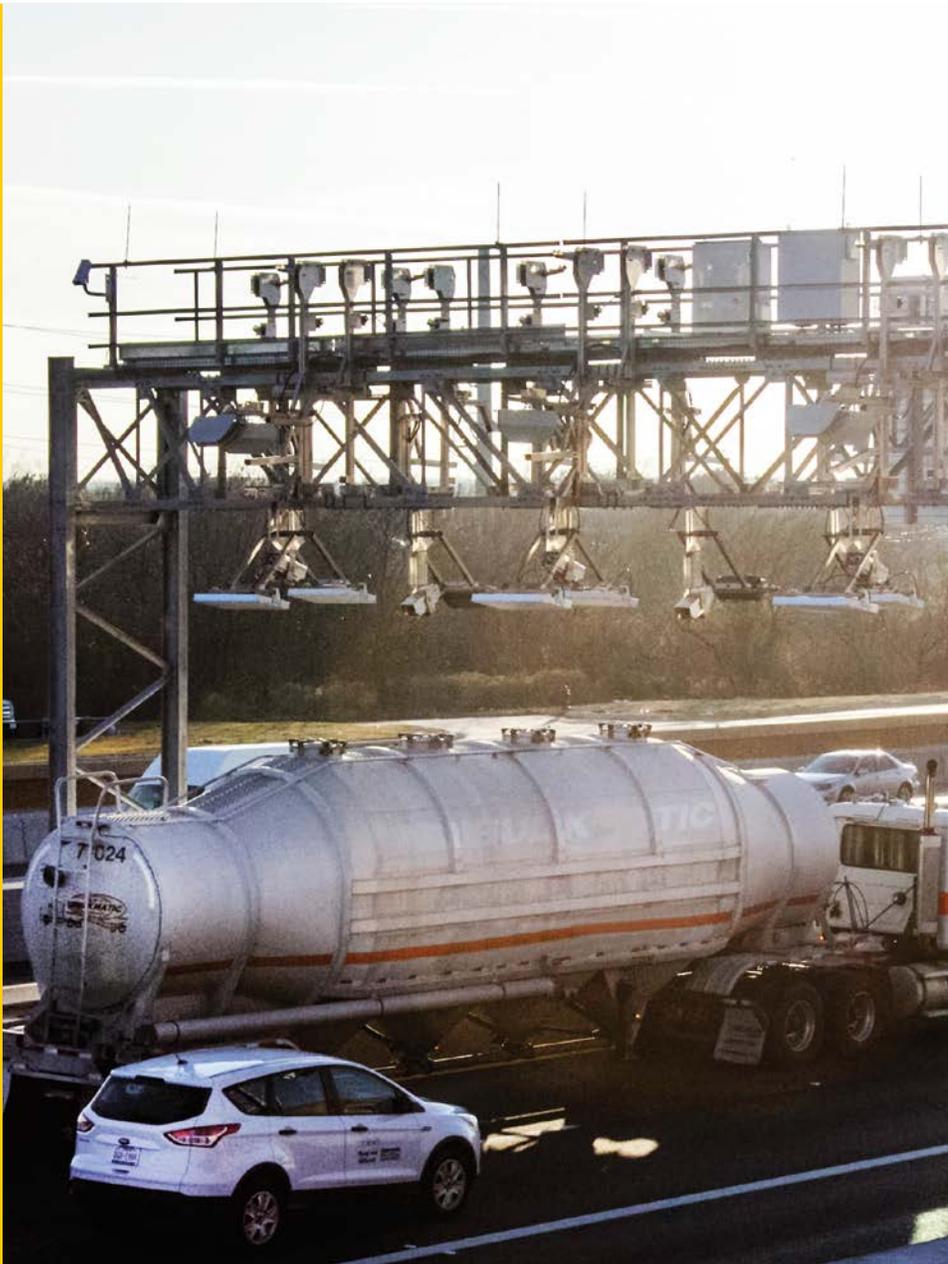
Kapsch also managed the physical infrastructure portions of the TCS and ITS project which comprised gantry and pole structure design, structural analysis, structure roadway placement, electrical design, fiber optic physical plant design and routing, and electrical conduit routing optimization (this does not include civil works such as infrastructure foundations). Work at the North Tarrant Express (NTE) involves the reconstruction of expanded frontage lanes and main-line lanes in the crucial I-820 and Airport Freeway corridor. The managed toll lanes (referred to as TEXpress Lanes) have been added along this 13.3-mile corridor. Both segments of the project were open and fully operational as of October 2014, significantly ahead of schedule. The main goal has been to provide congestion relief to one of the busiest highways in the state of Texas where freeway capacity has not kept pace with population growth.

The LBJ Freeway opened in 1969 to carry 180,000 vehicles per day. By 2008, traffic had risen to 270,000 vehicles—with a volume forecast of over 500,000 vehicles per day by 2020. With this level of demand better management of roadway capacity is the critical solution. The new LBJ Express (LBJ) encompasses a 17-mile corridor of expanded frontage lanes, general purpose lanes, and TEXpress managed lanes. These dynamically-priced toll lanes are intended to ensure a minimum predictable driving speed of 50 mph to drivers who elect to pay for expedited travel. The project also includes a lower section of approximately five miles, where the tolled managed lanes run under the general purpose lanes in an open tunnel. The first two segments of LBJ TEXpress (Segment 3B and Segment 1) commenced operations in December 2013 and July 2014 – each significantly ahead of the original timeline. Segments 2 and 3A will be operational in 2015.

Integrated Toll and Traffic Management System.

For these projects customer requirements specified a fully integrated TCS, ITS and an ATMS with the Central System. This includes the ability to perform transaction collection and efficiently managing traffic congestion. Sensors along the roadways determine real-time traffic conditions so that congestion can be managed in the corridor as often as every five minutes based on traffic volume in all lanes. Access to more reliable travel time enables better commute planning and encourages paid travel to corridor-wide destinations such as the Dallas/Fort Worth airport.

The Kapsch DYNAC ATMS® software provides incident management and vehicle volume data to the Central System, where the TSM's dynamic pricing algorithm calculates the tolls. Pricing information is pushed from the Central System to DYNAC for display on dynamic message signs, allowing drivers to make informed decisions whether to continue in the general purpose lanes, or to accelerate their trip by paying a designated toll. While the system is more complex than using a fixed-price table, the flexibility helps to consistently maintain optimal traffic flow. Forward-thinking operators and agencies around the country are upgrading their existing High Occupancy Vehicle (HOV) lanes with dynamic tolling options because of the beneficial impact on both revenue and traffic management. These roadways provide discounts to pre-registered vehicles with two or more passengers, thereby offering the advantages of HOV lane travel while also collecting tolls from single occupant vehicles that elect to pay for more predictable trip times.

Multiple Factors in Assigning a Toll.

Another function of this Kapsch system is the vehicle classification required to assign the appropriate toll amount based on vehicle class. The customer specifically wanted to avoid any in-pavement components for axle counting in order to avoid the downsides of higher maintenance and lane closures, while also requiring that alternative solutions be able to work with existing North Texas Tollway Authority (NTTA) systems. Therefore, the client's RFP required the selected vendor to be well versed in classification schemes outside of traditional road loops, as well as experienced in designing and delivering large scale projects. The solution proposed was a laser-based volumetric system utilizing proven Kapsch Laser Vehicle Detection and Classification (LVDC) scanning technology. This robust system creates vehicle profiles based on detailed measurements of more than twenty vehicle features including the height, width, and estimated length (i.e., box dimensions of each vehicle). Profiles are then used by the LVDC engine to assign a class to each vehicle based on a scheme pre-defined by the road operator. This is mapped back to the standard axle-based scheme the NTTA uses on all its other toll roads for vehicle classification.

A Toll **Tag-Independent** System.

Use of the TEXpress managed lanes does not require having an onboard vehicle unit (transponder) although more favorable toll rates are applied to drivers with existing accounts. From a single platform the Kapsch solution is capable of reading tags from other agencies throughout Texas, such as the NTTA Toll Tag, TxTag, EZ TAG, as well as HOV tags. The system is scalable for future interoperability by implementing the Kapsch Multiple Protocol Reader (MPR) technology.

For motorists without an onboard transponder, license plates are read via a video toll system using the Kapsch VR2 camera, capturing high definition front and rear images of each vehicle. Transactions are created in the lane and sent to the central system then once validated in the central system, the transactions are sent to NTTA. The NTTA billing system looks up driver records to generate a physical invoice that can then be paid online, by phone, by mail, or in person at NTTA customer service centers.

Fully Redundant, Single Gantry Solution with a Robust Traffic Management System.

The Toll Collection System (TCS) consists of all above-ground structures, toll gantries, and hardware; each toll zone is comprised of a unique, walkable single gantry for the placement of all equipment, which results in substantial cost savings in overall system design. Three major subsystems of the Toll Collection System include:

- Automatic Vehicle Identification (AVI) system using JANUS® MPR, antennas, and lane kits
- Video Toll System (VTS) using Kapsch VR2 cameras
- Laser Vehicle Detection and Classification (LVDC) system using Kapsch IP software for volumetric vehicle classification

All systems are fully redundant to avoid any single point of failure that would result in revenue loss or any system being "down." Each gantry contains a Toll Zone Controller (TZC) in a cabinet with back-up power generation. In the event of a TZC failure at a site, the system is set to carry information over the fiber network to another toll zone controller that can temporarily take over the failed TZC functions.

Powered by DYNAC software, the ATMS allows operations personnel to manage traffic conditions and incidents on the express lanes, helping to ensure a safe, reliable, and congestion-free trip for motorists. The system provides a streamlined visual display of real-time travel and weather-related conditions, as well as important data from the ATMS roadway devices and subsystems. HMI (Human Machine Interface) graphics provide an interface for monitoring and controlling assets such as message signs, air quality monitoring devices, microwave vehicle detection system, roadway weather information system, over-height vehicle detection system, digital video recording, and a CCTV (Closed Circuit Television) system.

When the system detects undesirable traffic states or incidents, alarms instantly notify staff. Operators can quickly view a live video stream from the source of the alarm event on the road. Based on incident classification details, the system recommends a response plan which can be modified for special conditions before executing the response.

The DYNAC Incident Response application supports various categories of incidents such as planned and unplanned events, and roadwork, each with separate classifications to identify the appropriate actions needed to restore conditions. Messages are prioritized according to severity level and operators are notified of any potential conflicting messages on the roadway devices.

Incident response plans are used to set and disseminate motorist advisory messages to signs located near the site of the incident, alerting travelers of upcoming travel times, hazardous road conditions, and other trip issues. This advanced warning enables commuters to choose alternate lanes or routes. The system publishes relevant travel information such as current sign messages to the client's website via RSS (Rich Site Summary) feeds. The ATMS system is designed to provide tailored information about the state of the road network to internal and external stakeholders with an interest in the area's traffic management strategy. Data such as facility/plan status, traffic conditions, incident response status and operational statistics is shared via a Kapsch-developed NTCIP (National Transportation Communications for ITS Protocol) C2C (Car 2 Car) interface with the regional TxDOT Traffic Management Center and other key area agencies. Stakeholders with network access can log into the ATMS servers to receive real-time updates.

Redundant ATMS servers are installed at each location to monitor their respective roadways; the LBJ ATMS and NTE ATMS operate completely independently. For emergency backup, a third server has been included for each ATMS system, installed at the opposite location to ensure physical redundancy. Failure detection and transfer of operations from the on-line server to the standby server is performed automatically with minimal disruption. The ATMS also enables monitoring of system performance, inventories, and maintenance activities on a 24/7/365 basis.

All Network Communications equipment present at LBJ is present at NTE with the same configuration to increase ease of maintenance and ensure autonomous operation of the networks at each facility. Special configuration allows redundancy to be maintained in the event of a single switch or link failure.

The entire roadside system, as well as the ATMS and the central system's Toll Setting Module, is monitored by the Kapsch Maintenance Online Management System (MOMS). MOMS runs regular health checks on all network devices and in the event of any failure, sends alerts based on incident priority to the Kapsch Technical Operations Center and the operator's Traffic Management Center. The MOMS trouble ticket functionality provides a single tool to manage all maintenance activity on the LBJ-NTE Field System and the Central System's TSM, including reporting functions on maintenance-related KPIs.

For these projects Kapsch provided all hardware, software, project management, detailed design, procurement, systems integration, testing, commissioning, training, maintenance, and warranty support. Kapsch developed interfaces to enable integration with proprietary subsystems for MOMS, TSM, C2C (NTCIP), DVR, and a web server.

North Tarrant Express 35 West (NTE 35W).

NTE 35W of the planned NTE construction involves the rebuilding of Interstate 35W, from Interstate 30 near downtown Fort Worth to north of the U.S. 81/287 "Decatur Cutoff." Kapsch TrafficCom will provide the same tolling and managed lanes system for the extension project. This increases tolling and ATMS coverage to approximately 40 miles of multi-lane expressway. The work is expected to continue through 2017.

Field System Features
■ JANUS® Reader-based AVI system
■ Kapsch VR2 HD Video Toll System
■ Overhead Laser Classification System based on Kapsch LVDC
■ Fully walkable toll gantries with retractable equipment arms for full overhead maintenance
■ Kapsch Maintenance Online Management System (MOMS)
■ Innovative redundancy concept to avoid any single point of failure

ATMS System Features
■ DYNAC ATMS® Software
■ Toll-setting module interface for price calculation
■ Display of toll prices via roadway VMS
■ HOV management
■ Incident detection and response
■ External traffic data sharing
■ Nonstop system performance, inventory, and maintenance activities
■ Enhanced reporting capabilities
■ Dual ring fiber optic network

	North Tarrant Express	LBJ Express	North Tarrant Express 35 West
Distance	13.3 mile corridor	17 miles in three segments	10 miles in two segments
Lanes	3 general purpose 2 frontage 2 managed per direction	4 general purpose 3 frontage 3 managed per direction	3 general purpose 2 frontage 2 managed per direction
Toll zones	11	18	10
Status	Fully complete and operational as of October 2014	Segment 3B: operational 2013 Segment 1: operational 2014 Segment 2; part of Segment 3: operational in 2015	Segment 3B in 2017 Segment 3A in 2018

Both the LBJ and NTE concessions are managed through a single operations center. Kapsch TrafficCom has a local office near Dallas to supervise both projects. State, local, and regional transportation planners laud the projects as a unique public-private partnership (P3) and a model for other "visionary" P3 financial opportunities in the state and across the country. Officials from member partners have touted the highway improvements as providing the convenience for drivers to have a seamless and reliable trip throughout the North Texas region, "connecting Fort Worth and Dallas like never before," with a dynamic tolling model that offers travelers a choice. This kind of enhanced mobility is seen as a critical part of economic development as well as an improvement in quality of life for the local population, "and these new corridors will have a significant impact on both."

Kapsch TrafficCom.

Kapsch TrafficCom is a provider of intelligent transportation systems (ITS) in the application fields of road user charging, urban access and parking, road safety enforcement, commercial vehicle operations, electronic vehicle registration, traffic management and V2X cooperative systems. We cover the entire value creation chain of our customers with end-to-end solutions. From components and subsystems to their integration and operation. Our core business is to design, build, and operate electronic toll collection systems for multi-lane free-flow traffic.

About Kapsch Group.

Kapsch is one of Austria's most successful technology corporations to specialize in the future-oriented market segments of intelligent transport systems (ITS) and information and communications technology (ICT). Kapsch. Always one step ahead.

Kapsch TrafficCom North America | 8201 Greensboro Drive, Suite 1002 | McLean, VA 22102 | USA

Phone +1 703 885 1976 | Fax +1 703 790 9100 | E-Mail: ktc-natolling@kapsch.net | www.kapsch.us | www.kapsch.net