

Tolling technology and integration in the 21st century – Not your father's toll solution



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Ageing Infrastructure-The Interstate system is now well over 50 years old!

- The Interstate highway system of 62 super highways consisting of 42,795 miles was originally built to 25 year design life
- The largest highway system in the world
- As a project scale it is larger than the Great Wall of China or the Suez Canal and the largest earthmoving project in the world
- The highway has 54,663 bridges and 104 tunnels
- Paid for by primarily by a highway gas tax



Ageing Infrastructure-The Interstate system is now well over 50 years old!

- The roadways bridges and tunnels are tired and in need of attention
- Traffic congestion severely limits the country commerce and is a throttle to our GNP growth
- Expansions are very difficult and extremely expensive
- In 2005, ASCE estimated \$1.6 trillion investment needed of over a five-year period from all levels of government and the private sector to remedy problem
- 2007 congestion cost about \$87.2 billion (based on wasted time and fuel, Texas Transportation Institute)
- At least 96 interstate highway bridges rated 'structurally deficient' by government inspectors in 1982 had the same rating [in 2006] (USA today)



The Funding mechanism for “free roads” is broken

- The fuel tax worked well in 1959 when cars got 8-12 mpg
- It even worked in 2003 when SUVs got 10-15 mpg
- But we have problems in 2009 when hybrids get 45 mpg
- And what about 2019 when electric cars get 200+ mpg?
- The Highway trust fund is being tapped for transit and other non-highway applications: Between 2004 and 2009, ~40% of Highway trust fund was not spent on highway improvements
 - \$78 Billion was spent on non-highway infrastructure improvements (GAO report commissioned by Senators McCain and Coburn). ~193 Billion total spent (FHWA)



The Toll Road Solution!



Traditional Toll road Advantages & Challenges

■ Advantages

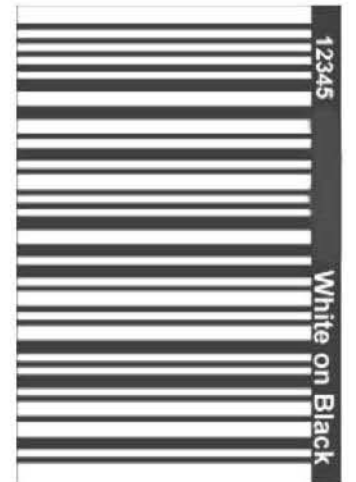
- The perfect user fee – those who use the road pay
- Ongoing revenue stream pays for road maintenance and enhanced services
- Allows states the ability to expand the road infrastructure

■ Disadvantages

- Toll Plazas generate traffic congestion
- Toll Plazas are hazardous and prone to accidents
- High operational costs



Toll Collection – Evolving technology over time

A photograph of a toll table with various rates and a "NO U-TURN" sign. The table lists different vehicle types and their corresponding toll amounts. The sign is red and white.

Toll Collection – Evolving technology over time



The next step tolling evolution: cashless toll collection

Open road tolling is:

- Cashless, barrier-free toll collection
- Payment by transponder or license-plate reading

Advantages:

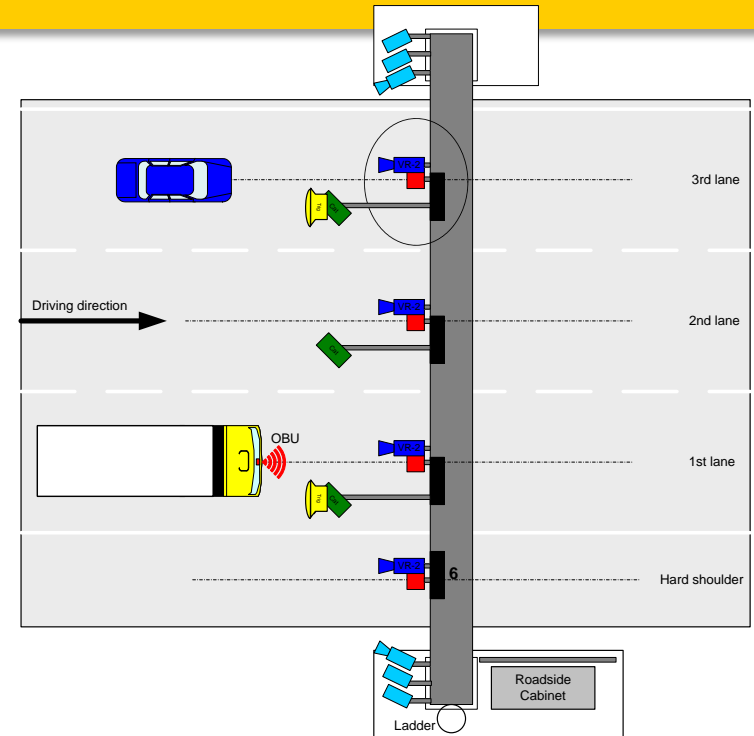
- Much safer/fewer accidents
- Overall lower cost to collect toll
- Much less congestion

Disadvantages:

- Complex to collect tolls from customers without transponders

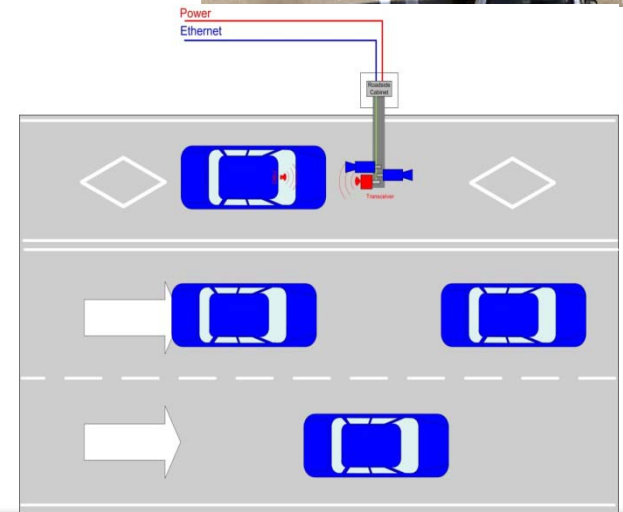
New Technology tools for the customer and the integrator

- The localization challenges of ORT can be best addressed by 5.9 GHz WAVE DSRC platforms due to the higher accuracy. These platforms are also not proprietary which provides for nationwide interoperability.

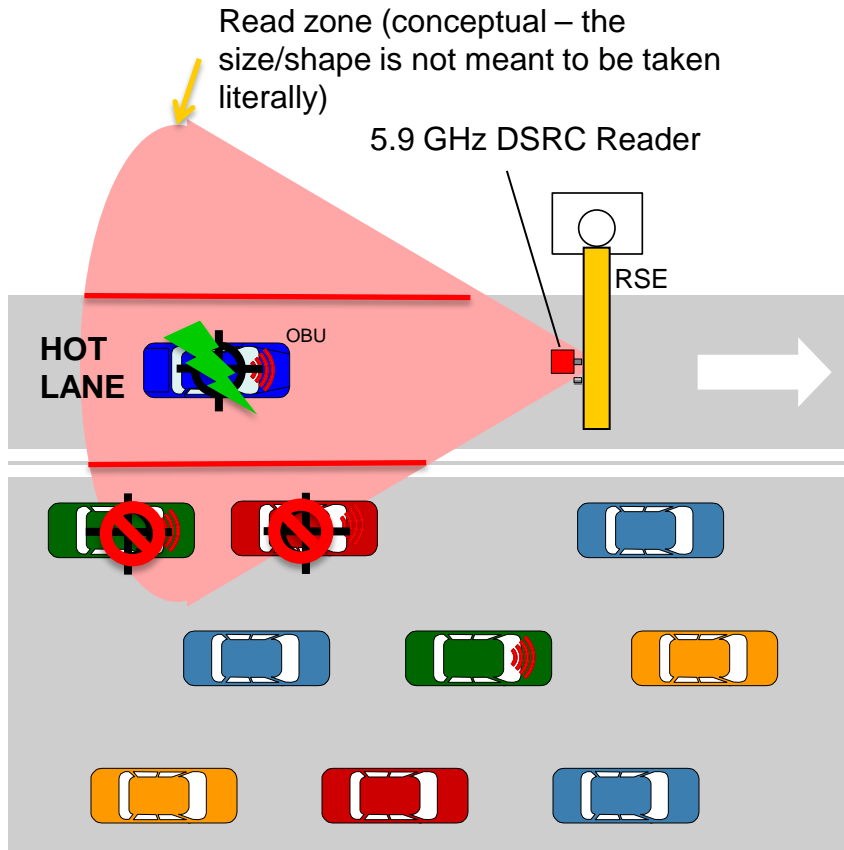


The current frontier of tolling: High Occupancy Toll (HOT) lanes

- **HOT lanes:**
 - Single Occupancy Vehicles use HOV lanes for a fee
- **Advantages:**
 - Make better use of existing infrastructure (HOV lanes)
 - High degree of public acceptance
 - Potential for self-financing infrastructure
- **Disadvantages:**
 - Unclear whether HOT lanes income sufficient to cover costs except in very high demand areas
 - Not sufficient funding for building complete new roadways
- **Challenges**
 - Lane discrimination
 - Vehicle Occupancy
- **New Technologies:**
 - Self-declaration transponders
 - Smaller antennas with precise lane discrimination
 - Mobile enforcement vehicles



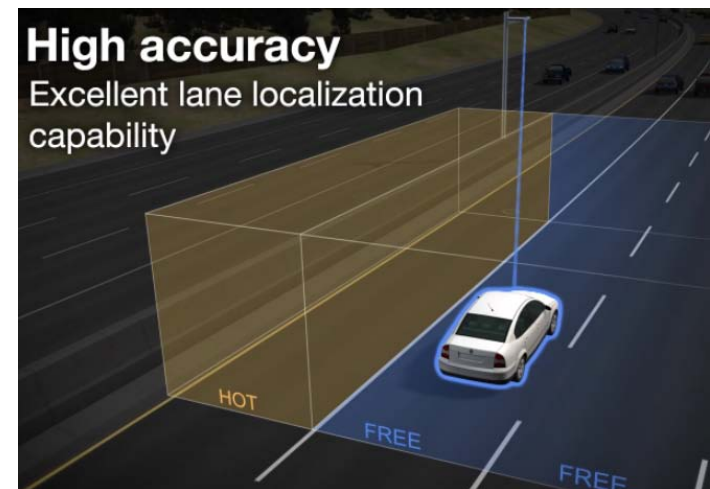
No Incorrect Transponder Reads



- The 5.9 GHz Dedicated Short-Range Communication (DSRC) Transceiver can determine the location of the transponder on the highway based on the signal alone
- Ideal for Open Road Tolling (ORT) and High-Occupancy Tolling (HOT) lanes
- Enables very high percentage of correct transponder reads
- Eliminates False Positives from non-HOT lanes

Why 5.9 GHz DSRC?

- Open source (technology public—not owned by a single company)
 - Standardization of equipment, robust supply chain
 - Competition, multiple vendors – lower prices
 - No vendor lock-in
- Standardized by IEEE as “WAVE”: IEEE 802.11p & IEEE1609.x
- Adoptable to long- and short range communication zones provides the best of both worlds:
 - Wide Range Communication over 3000 ft.
 - Exact Lane-Level Localization



The new generation of tolling based on 5.9 GHz DSRC

- Compact roadside equipment - Transceiver has over 18 built-in antennas, which allows for exceptional lane-level localization
- Provides loop free operation



The new generation of tolling based on 5.9 GHz DSRC

- Easy to install, commission and maintain
- Outside of the initial setting of the antenna angle, all commissioning is done out of the lane using a laptop and web interface to complete the entire lane commissioning process.
- Transition from legacy toll system to 5.9 is easy and pain free – has been proven on several installations that 915 MHz and 5.9 GHz DSRC can operate side-by-side without operational interference.



5.9 GHz Systems Enhance Corridor Management

- Intersection SPAT and ramp metering
- Variable speed limits
- Managed Lanes, Open Road Tolling (ORT), and HOT lanes
- Traveler information and in-vehicle signage
- Commercial vehicle electronic screening and weigh station bypass
- Enhanced probe data

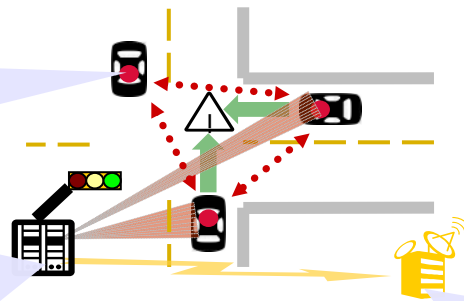


On Board Unit

- Red light warning
- "Green speed"
- Traffic signal priority

Road Side Equipment (RSE)

- Broadcasts signal countdown
- Broadcasts intersection map
- Collects vehicle probe data
- Distributes signage



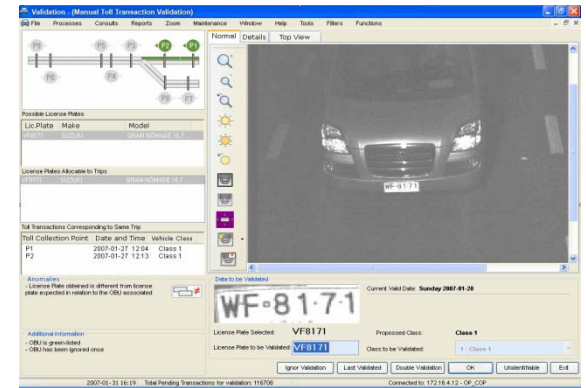
Backhaul Network

- Delivery of traveler information
- Delivery of traffic data to Traffic Centers



Alternative toll collection technologies

- **Video tolling:** Tolling based on Automatic License Plate Reads
- **Advantages:** No in-vehicle hardware needed
- **Disadvantages:**
 - Many state license plate databases are incomplete;
 - Poor legal basis for interstate toll enforcement
 - Manual verification often required → high labor costs;
 - Cost to collect toll will always be higher than DSRC;
- **5.9 GHz WAVE:**
 - New protocol specifically allocated and designed for a host of ITS applications, specifically including nationwide interoperable tolling
 - Platform to handle interactive applications, provide security for higher value transactions
 - Convergence with other ITS applications:
 - Emergency, weather, and travel information
 - Safety: intersection safety and collision avoidance



The future of tolling is tag free, but leans heavily on DSRC

- Just as a cell phone merged with PDA to make smart phone, toll tag will merge with other electronics
 - Built into automobile
 - Built into phones, PDAs
- Market will demand convergence of toll tags will merge with other electronics (navigation devices, cell phones) for customer convenience
- Interoperable
- Non-proprietary: benefits of open source procurement.
- New generation of users will expect device to do multiple tasks
- Superior enforcement methods: mobile enforcement



Not your father's toll solution!

- **Tolling integrators in the 21st century will be expected to provide agencies with:**
- Interoperable open-source solutions with increased competition—no technical lock-in
- Tolling Integration expertise for evolving tolling configurations such as ORT and HOT lanes
- Enforcement and back office solutions for gantry-less installations
- Seamlessly combinations Video / DSRC / GPS tolling to ensure the most cost effective operations to collect tolls.
- Tolling systems that support payment via integrated devices like PDAs or smart phones including toll payment applications. The future of toll payment is an application on a one platform for all needs, PDA-type device.
- Economies of scale not previously envisaged:
- In both Illinois and New York, only about 28% of registered vehicles have toll tags.

The Challenge to Integrators



Thank you for your attention

Bob Frank – Director of Business Development

robert.frank@kapsch.net

(202) 256-6186

Kapsch TrafficCom IVHS

21515 Ridgetop Circle | Suite 290 | Sterling, VA 20166

Phone (703) 885 1976 | Mobile: (202) 531-9034

Web: www.kapsch.net | www.kapsch.us

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