Harnessing the Power of IT with Electronic Tolling

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Slide 1—Harnessing the Power of IT with Electronic Tolling

Whether you are a government agency or a private financier, whether it is a new tollroad or one that is being considered for electronic toll collection, how is your organization going to make money on its investment?

Of course, there is no easy answer to that question. BUT…

…We all know the power of information. That's why were here today. To exchange information. When information technology–or "IT"–is harnessed with electronic toll collection, you get results. You WILL find your profitability by marrying exceptional IT with exceptional electronic toll collection.

Today, I'd like to explain what electronic toll collection—or ETC—is, how it can be used, and how it can add to your bottom line.

Usually, tollroads are built to generate revenue for a variety of purposes — most notably for construction and maintenance (including resurfacing, restoration, rehabilitation, and reconstruction). Today, privately financed tollroads are built to make a profit.

As costs of highways increase, tollroads are making a comeback. The first tollroad privately financed in the U.S. since 1840, the Greenway in Northern Virginia, opened this year and expects to break-even in 2003. Ownership remains in a limited partnership, with long-term financing from a consortium of insurance companies. According to some estimates, Indonesia expects to see 40% of their infrastructure projects built with private funds.

The increased popularity of tollroads emanates directly from several social factors associated with increased congestion.

- Protracted community opposition to new road construction
- Diminishing government funding for large-scale highway projects
- Use of well-traveled roads regularly exceeding capacity;
- A 250% increase in total vehicle-hours of delay (1990–2005)
- Resulting increase in cost of goods (shipping costs increase)
- And the 70% increase of urban populations since 1970 in suburbs.

Slide 2—The focus of ETC IT

- **Use IT to determine strategy**
- **Use IT to enhance operations**
- **Use IT to determine customer satisfaction**

Collecting information on traffic, such as volume and peak hours, is essential to efficient management of your road, regardless of the level of IT development.

IT is used to determine and to meet customer satisfaction. IT is also used to determine how, where, and when to market.

The idea of intelligent transportation systems (ITS) is mostly about information. Collecting it. Analyzing it. Distributing it.

Finally, let's not forget the focus of our attention: The Customer.

- What are the customer's needs?
- What is technologically possible to meet those needs?

The information you can collect and analyze can tell you traffic flow trends and how you can adjust toll rates to encourage better flow through. IT can also help you determine the best use of tolls to maximize profits.

Slide 3—Your options

vManual
vCoin
vSmart card
vElectronic (ETC)
vCombination

Your usual methods of toll collection are Manual, Coin. You now have an additional option—and that is electronic toll collection— or ETC.

Most toll roads today use some combination of at least the first two methods. Increasingly, all three methods are being used in combination.

Manual is simple, but labor-intensive. As much as 80% of toll plaza costs are for labor. With both manual and coin, drivers must come to a halt or near halt. The only way to increase flow through the toll plaza is by installing and staffing additional toll booths. Certain anonymity.

Coin. From a machinery perspective, automatic coin machines (ACMs) are fairly basic. Few moving parts makes the cost of maintaining these machines relatively simple. And coin collection provides definite anonymity. The collecting and counting of coins is best subcontracted to a bank so that the coin vaults do not have to be opened at the toll plaza. But coins are heavy and cumbersome.

Smart card. With the popularity and interoperability of smartcards, this is an option that you cannot overlook. Collection is almost theoretical because no physical money handling is required at the toll plaza. However, the vehicle must still slow to a stop at the plaza to ensure the card is "swiped"

well. Interoperability is what everyone is striving for and advertising, but it's not there yet.

A few benefits of **ETC** are:

Ease of use. No coins or cash to cart from toll plaza to the bank.

Time savings for motorists (assuming the total demand for the system is constant and that vehicle queues are not shifted downstream).

Non-stop ETC can **help avoid accidents** at toll stations from deceleration, acceleration, lane changing, etc.

Variable rates. Rates can varying and be dependent on the hour of travel, the car density (congestion), size, type of vehicle, etc. We'll talk later about what SANEF in northern France did with variable rates.

Examples. Since 1986, ETC has been used for buses using the Lincoln Tunnel (NYC). The Dallas North Tollway has been using ETC since 1989; the ACESA Highway in Barcelona Spain since 1990, the ESCOTA Highway in Antibes, France since 1990, the Autostrada in Milan to Naples since 1990; and in Oslo, Norway, the Toll Ring, has used ETC since 1990.

Slide 4—Your options (cont)

- **Cash only**
- **Cash and token**
- **Stickers**
- **Electronic**
  - **ucredit-based**
  - **udebit-based**

Payment options can include automated cash-and-token toll stations, pre-dated windscreen stickers, user-dated or self-canceling stickers, hybrids.

With ETC, payment options include:

- Credit-based. Facility use is recorded and users pay at a future point in time. Can bill users periodically or transfer funds from a specified account electronically
- Debit-based. Must pre-pay for the use of the facility and the unexpended balance is reduced each time the facility is used. Can be based on a device per vehicle. Increase balance at the toll plaza or at a payment station or a central facility, or funds can be transferred electronically.
- Shadow tolling. Public partner pays the private partner for all or part of the design, build, finance, operation, and maintenance of road management services.

Slide 5—Your options (cont)

- **Improved**
- **Non-stop**
- **At-speed**

With ETC, your method of collecting options increase. You can have

- **Barriers.** That is, you can use a traditional toll booth collection station but with the transaction speeded by using ETC technology. The vehicle comes to a complete stop and proceeds.
- **Non-stop.** The toll is collected at a traditional station but the vehicle does not come to a complete stop.
- **Open highway** or **"at-speed".** In an open highway, the motorist does not have to slow down, nor take any action to have the toll collected. This process is automatic.

Slide 6—What is ETC?

ETC is the use of technology

- **To collect revenues**
- **To expedite operations**

ETC–Electronic Toll Collection– is automated vehicle identification (AVI) and MORE.

Revenues from toll collection pay for the road and fund maintenance and road infrastructures.

Both passenger cars as well as freight bearing commercial traffic are at the mercy of your toll collection methods. ETC expedites the flow of traffic.

Slide 7—ETC on an open highway

This artists rendition is an example of an open highway ETC found on highways like California SR-91 or the Foothills Corridor.

Slide 8—ETC advantages

- **Ease of collection**
- **Convenient to user**
- **Increase vehicle throughput**
- **Collect data and autometrics**
- **Accuracy**
- **High reliability**
- **Safer, more efficient highway operation**
- **More options for enforcement**
- **Environmental improvements**
    - Manual—high accuracy rate, but lowest through-rate. Then, of course, there is always human error…
    - Coin—approximately 98% accurate. But then someone has to collect all the coins.
    - AVI –Reality vs. expectations of 100% for valid transponder holders
    - TIRIS –World class engineering, product reliability and service.
    - Low cost. Less expensive to build and operate than traditional toll roads.
    - Faster throughput. Speedier and getting from point A to point B more important than cost.
    - Ease of use
    - Safe, more efficient highway operation.
    - Also reduces congestion, pollution, productivity losses. For example, it's hard to get anything done when sitting in the middle of a freeway parking lot.

Slide 9—ETC disadvantages

- **Complex**
- **Higher technology**
- **Easier to violate (open lane)**
- **PERCEIVED lack of privacy**

ETC is in the developmental stages. The economic benefits of ETC could be more widespread if standards were already established and more interoperability between systems existed. Currently, there are many different methods of ETC as well as many different vendors.

Most IT systems associated with ETC already accommodate maintaining the privacy of the individual with anonymous accounts. However, it is an issue that must be addressed openly.

Slide 10—System components

- **Roadside**
  - **AVI**

    Includes detection. The antenna reader, the transponder, and the comlink.
  - **Classification systems**

    The system determines the type of vehicle coming through.

    Most classification systems use light curtains, treadles, loops and other roadside devices to classify vehicles.
  - **Enforcement systems**

    One type of enforcement system captures images of a license plate of cars not in compliance, such as without a vehicle without a transponder that is using the AVI lane.

    The ETC system must determine if the vehicle has a valid account, and if so, if sufficient funds exist . If not, the system must determine if the onboard debit card has sufficient funds.

    Video cameras, contracts with the police, physical barriers, etc. Sometimes, regardless of the technology, low tech enforcement practices may be the only ones available. For example, with the Greenway project in Virginia, the owners do not have the legal power to ticket toll-evaders. Physical barriers at the plaza gates are the only kinds of restrictions. Cameras cannot be installed until the right to prosecute is gained.
  - **Controllers**

    The lane computer provides control and timing of the road side devices.
- **Central Office**
  - **Backend operations**

    Maintains accounts, balances, data analysis, and billing operations
  - **Tag stores**

    Provides distribution of transponders, customer interface, and customer training.

Slide 11—Roadside

1. Vehicle sensor. Lets system know a vehicle is approaching.
2. AVI transponder. A transponder that stores information, such as prepaid amount and ID information.
3. Antenna. Sends radio signal to AVI transponder, receives response, and may also write data back to it.
4. Roadside receiver. Collects data, decodes the transponder data, classifies vehicle, and transmits information back to central station.
5. Enforcement camera. Takes a photo if a vehicle has not correctly paid a toll charge

Slide 12—Central Office

- **Backend operations**
- **Tag stores**

The backend operations provide account management.

Essentially, what you put in is going to determine what you get out. To truly maximize your profits, you must know what you are dealing with: toll revenue–actuals and projected; toll facility sizes and future growth capabilities; equipment needs based on levels of service offered, initial supply and future replacements;impact of marketing and operational strategies on toll revenues; and so on.

The tag stores are the retail outlet for transponders and account management.

Besides aiding you in collecting tolls, ETC can help you monitor and collect data on your operation. But the efficiency and effectiveness of ETC is only as strong as your backend offices and your overall ETC policies and strategies.

Slide 13—Using ETC

- **Cost issues drive the ultimate success or failure of electronic toll traffic management… <u>NOT</u> technology.**

In today's world, to minimize costs and maximize profits you must consider employing ETC to manage traffic. ETC provides solutions for controlling rising toll collection costs. But before we get into how ETC does this, let's see how you get from where you are—minimal IT and no ETC—to where you are using both.

But be aware that institutional and cost issues drive the ultimate success or failure of ETC. NOT technology.

ETC helps in determining the economics of the project—before and after implementation.

ETC will help you flush out operational issues.

ETC can help you in determining policy.

Slide 14—To evaluate ETC for your operation:

1. **Determine existing costs per transaction**
2. **Determine ETC *capital* costs**
3. **Determine ETC costs per *transaction***
4. **Analyze your results**

Slide 15—Determine existing costs per transaction

- **Toll Collector**
- **ACM Depreciation**
- **ACM Maintenance**
- **Bank Pickup**
- **Bank Counting**
- **Plaza Supervisors***

Ultimately you will want to determine your per transaction cost.

This list is an example of major cost units found at most toll plazas.

First, determine what your units are and then find out the annualized cost of each for one toll plaza.

How many lanes? How many coin machines? How many booths? How many transactions per year? What percent of transactions are collected manually? from ACMs?

Toll collector costs include salary, fringes, and other burden. Peak hour staffing varies with the road and regional differences.

Many systems, which include coin machines (ACMs), have an established relationship with the local banks to provide coin and cash pickup as well as counting.

Note that since supervisory staffing is required 24 hours a day in most cases, this cost will probably not be affected by the introduction of ETC.

When we look at the cost of collecting tolls, the cost of ACM equipment plus bank charges is small in comparison with staffing costs. This is the figure to beat when comparing the cost of ETC per transaction.

Slide 16—Example: ETC *capital* costs for a toll bridge

Scenario: Tagged vehicles are 40% of market.

This scenario is used simply to illustrate the process you must go through to evaluate ETC. Percentages for your operation and others will be different.

Slide 17—Determine ETC capital costs

- **Plaza**
- **Lane**
- **Backend computer**
- **Transponder**
- **Marketing**

Costs associated with the AVI lane include the equipment for the AVI, for classification, enforcement, and lane control (computer), as well as backend equipment costs.

Computer operating costs, including the "backend" computer, communication links, and transaction processing costs, associated with the system must also be accounted for. Be sure to include the cost of the systems integrator who will design, program, and implement the ETC for your needs and operation.

Don't forget to include the costs of transponders in your capital costs. (Usually, these are "loaned" to the motorist after an account is established and a deposit is made.)

DO NOT forget marketing costs for the initial campaign. Introducing a new way to do things always requires an educational campaign. ETC is no exception.

As market share increases, the number of transponders required also increases as do capital costs.

This chart is based on a 40% market share. In this example, 70% of toll collection through automatic coin machines.

Slide 18—Example: ETC *transaction* costs for a toll bridge

Scenario: Tagged vehicles are 40% of market.

Again, this scenario is used simply to illustrate the process you must go through to evaluate ETC. Percentages for your operation and others will be different.

Costs vary per tollroad size, the mix (manual, coin, and ETC), and location, but generally, this is a good percentage. Note: No specific $ or £ amount can be specified.

Slide 19—Determine ETC costs per transaction

- **Maintenance**
- **Enforcement**
- **Depreciation**
  - **Tag**
  - **Lane**
  - **Other**
- **Tag store**
- **Backend office**

Obviously, as market share for ETC increases for all toll transactions, cost per transaction decreases.

Depreciation costs will most likely be the major factor in determining the cost per transaction for ETC. Of course, this cost is directly tied to the capital costs. Minimizing capital costs plays a large role in keeping a lid on depreciation expenses and therefore operating costs are minimized.

Equipment includes the readers, the antennas, interfaces to the lane controller, and video enforcement cameras.

Remember, ETC is most useful for increasing volume. Using coin machines is usually more cost effective if volume is not an issue.

Slide 20—Analyze your results

Slide 21—Planning…Determine

- **Strategy**
- **Options**
- **Costing and pricing**
- **Implementation**

Once you've determined that ETC will be profitable for you, you can proceed to plan your project. Determine your

- toll strategy

  This where you determine the mix of the three options (manual, coin, ETC) and determine your plan for growth.
- options, including facilities makeup and applicable standards
- costing
- plan for implementation

Slide 22—Determine toll strategy

- **Traffic volumes**
- **Peaks**
- **Growth**
- **Sensitivities**

Toll Strategy. Solutions that are safe, secure, affordable and appropriate to the level of development of the community in which it resides. Local conditions, customs, vehicle loading standards, levels of law enforcement, safety standards. Should reflect data on volumes, peaks, growth and sensitivities.

What are the possible impacts on revenues from political issues, marketing and operation strategies?

Plan for volume to increase over time.

Slide 23—SR-91

For example, State Route 91, or SR-91, is a 16-km-long stretch of key real estate east of Los Angeles. With 250,000 vehicles per day and a daily 4-hour-long peak, this 10-mile stretch of concrete is one of America's most congested commuter corridors.

At the end of 1995, four new express lanes were opened for commuters who had subscribed to the FASTRAK Express Lanes system. Texas Instruments and MFS Network Technologies installed the ETC system. Without reducing speed, motorists who have an established account on the system and have installed the transponder, can use the express lanes for about US$1.75 a trip. However, depending on the hour, rates vary from US$2.50 at peak hours to US$.25 in low usage hours. These rates can be adjusted in response to traffic volumes as well. Electronic variable message signs, located 1 kilometer before each entry point, reflect the current rate.

The tollroad's operator reviews pricing policies every few months.

With an accuracy rate greater than 99.98%, Texas Instruments' TIRIS AVI system automatically recognizes the transponder, and the toll is automatically deducted from the motorists' account.

Behind the scenes, SR-91 uses a Digital Equipment Corp computer system based on a UNIX operating system and an Informix relational database. Fiber optic cabling provides high-speed comlinks.

SR-91 is owned by the California government and leased back to the limited partnership that built and is operating the road. The franchise is for 35 years at which time the road reverts to state operation.

In another example, the Tappan Zee Bridge just north of New York City replaced 8 toll booth lanes with 5 electronic lanes so that traffic could pass through more quickly.

Slide 24—Determine options

vFacilities

vStandards

Determine your needs—as the owner? as the prime contractor? When and what your break-even is for your investment. What level of commitment is required for the project to work?

Determine toll patrons' needs and benefits. Greatest benefits of ETC are going to be convenience and increased throughput.

What are the road's attributes:

- Closed (all access and egress points are monitored)
- Open (only main points are monitored)
- Partially closed
- Are you charging both directions or only one? Bridges between governmental boundaries, for example.

Determine toll facility sizes and lanes for opening and future expansion.

Will you be replacing booths or ACMs? Or will you be building new lanes to accommodate the ETC?

What standards will be in place by the time the ETC will be in place?

Are you going to add new lanes to add ETC or are you going to replace existing ACM lanes or existing toll booth lanes with ETC lanes?

Slide 25—The Transponder—Your ETC link to traffic management

When in use, the transponder is the automatic link between each motorist and your information system. Data about the user's account is automatically updated in the backend computer as the AVI system notes the vehicle. The TIRIS transponder holds an account identity and certain other data you may want to collect such as time and date, entry and exit points, and distance traveled. Data collected is determined by you, the operator.

Slide 26—Determine costing and pricing

- **Pricing methods**
- **SANEF example**

Determining the costing of each ETC transaction cannot be taken out of context; it must be considered along with the other methods of toll collection. The number of ETC transactions is also dependent on the number of regular subscribers and the regular marketing of the service.

A number of factors are involved in pricing. It should be highly reflective of the overall toll strategy. For example, if you are using ETC to level out throughput to diminish standard congestion during peak periods, ETC can help you establish variable pricing without too much effort.

But whatever the philosophy you establish for your pricing, it is wise to keep your potential users informed every step of the way.

According to some reports, the Oklahoma Turnpike's electronic toll collection system cut the state's operation costs per toll lane by 91%.

Slide 27—Pricing methods

- **Flat**
- **Distance traveled (ticketing)**
- **Variable**
  - **per axle**
  - **per time (maximum at peak periods, e.g., for recreational use)**

Combinations of above, too.

Slide 28—An example: SANEF variable rates

- **Goals:**

Reduce congestion on A1 to/from Paris.
Lower fuel consumption and exhaust gases.
Improve driving comfort for the motorist.
Maintain safety.

SANEF (Northern and Eastern France tollroad company) officials determined that it needed to spread demand over a broader period of time to reduce congestion, especially for weekend and holiday traffic leaving from and returning to Paris. Management also wanted to 1)lower fuel consumption and polluting gases from exhaust; 2)improve the motorists driving comfort; 3)Achieve these goals without decreasing safety for the motorists.

Slide 29—An example (cont)

Strategy: Spread demand over a broader period of time.
How: Vary rates.
Run a communication campaign.

From April 26, 1992, SANEF has been modulating its toll rates on the A1 tollway for weekend return traffic to Paris. Estimated gross in 1994: US$ 656 million. Average daily traffic: 50,000 vehicles. Type: 30% trucks. V/d exceeds 80,000 (at both ends) on peak days.

10,000 questionnaires distributed. 2200 replies.

75% would take the lower price if rates raised during peak hours.

Slide 30—An example (cont)

Toll rate is modulated 25% of the motorist's itinerary and added to the basic rate during the red period (16:30-20:30 peak hours) and deducted during the green periods (14:30-16:30; 20:30-23:30) Traffic data from 1986–1993 was used to determine traffic periods and to monitor changes.

During the first 2-yr period, traffic increased 5% but fell 12% during the red period, with the differences spread on either side in the green periods.

Cutting down on congestion reduces fuel consumption and exhaust emissions.

Concessions are not negatively affected.

Using IT to monitor traffic, SANEF officials learned that:

- Rate modulation must be applied at the very point where there is a real risk of saturation. The system of modulation must be clearly conveyed to the motorist.

- Any toll increase at a specific moment or time has to correspond with a decrease so that they can cancel each other, giving the motorist options.
- The price difference between the highest and lowest must be as wide as possible and significant enough to influence motorist behavior.
- Affects normal weekend traffic, but not so much seasonal (summer) traffic.

Slide 31—Determine implementation

Marketing
Distribution

- Set up a marketing campaign

  The importance of marketing cannot be underestimated. Maximum ETC program usage creates maximum return on your investment. Regardless of the success of the construction phase, the planning and execution of a marketing campaign in the early phases of adopting any new technology can significantly increase the acceptance rate.

  For example, by the time Windows 95 formally was released it was 2 years late. But Microsoft's extravagant marketing campaign ignored this fact. The result: lines formed outside retail outlets on the day the software was formally being released. Microsoft used the built up demand to its advantage.

  Keep your potential market informed of what is happening by using the local media, leaflets, briefings, and any other appropriate media vehicles.

  Keep your potential users informed of what they can expect when the new use of the road is implemented. Let them be a part of the "action." AVI subscription, transponders, discount cards, etc., should be marketed early so that subscribers can prepay well in advance of the actual opening.

  Newspaper campaigns, customer surveys and advertisements handed out at the toll booth, and telemarketing are just a few ways of getting in touch with your potential users.

  In this example, a large sign was placed over the empty AVI lanes of SR-91 to entice drivers caught in congested traffic.

  Remember to market the convenience and not the technical aspects of ETC.

- Distribution

  Initially, open multiple sites for the sale and distribution of transponders. Use this opportunity for a face-to-face with your customer, to provide training and to identify your customers.

  Use banks, trailers, and other outlets for temporary sites to meet initial demand. 85% of the users will sign up in the first 3 months (this is true for both Europe and the U.S.).

For renewals and for new endeavors, such as a new variable rates or the addition of another AVI lane, you can use mail and telemarketing to keep demand steady.

Again, the focus is on the customer and customer satisfaction.

Slide 32—Summary

vUse IT to determine strategy.
vUse IT to enhance operations.
vUse IT to determine customer satisfaction.

Remember, there are no FREE roads. Users of non-toll roads pay the price of inconvenience whether hours are lost because of congestion or because the route is indirect. The other expense that is seen only indirectly is, of course, the taxes are assessed on everyone to support road maintenance and upkeep. Seldom do you really see the personal and individual impact of this assessment, but it is there nonetheless.

Nevertheless, there is the PERCEPTION that tollroads cost and other roads do not. Your goal is to collect tolls in the most-effective manner possible to run and maintain your road well and to maximize your profitability.

Finally, the most efficient and effective method of operating your tollroad is to never, ever forget your customers.

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