

## VII Proof Of Concept Tolling Overview

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- ▶ VII Consortium
- ▶ Presented to
  - ▶ the 2009 Symposium on Mileage Based User Fee
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    - Austin , TX

# POC Overview

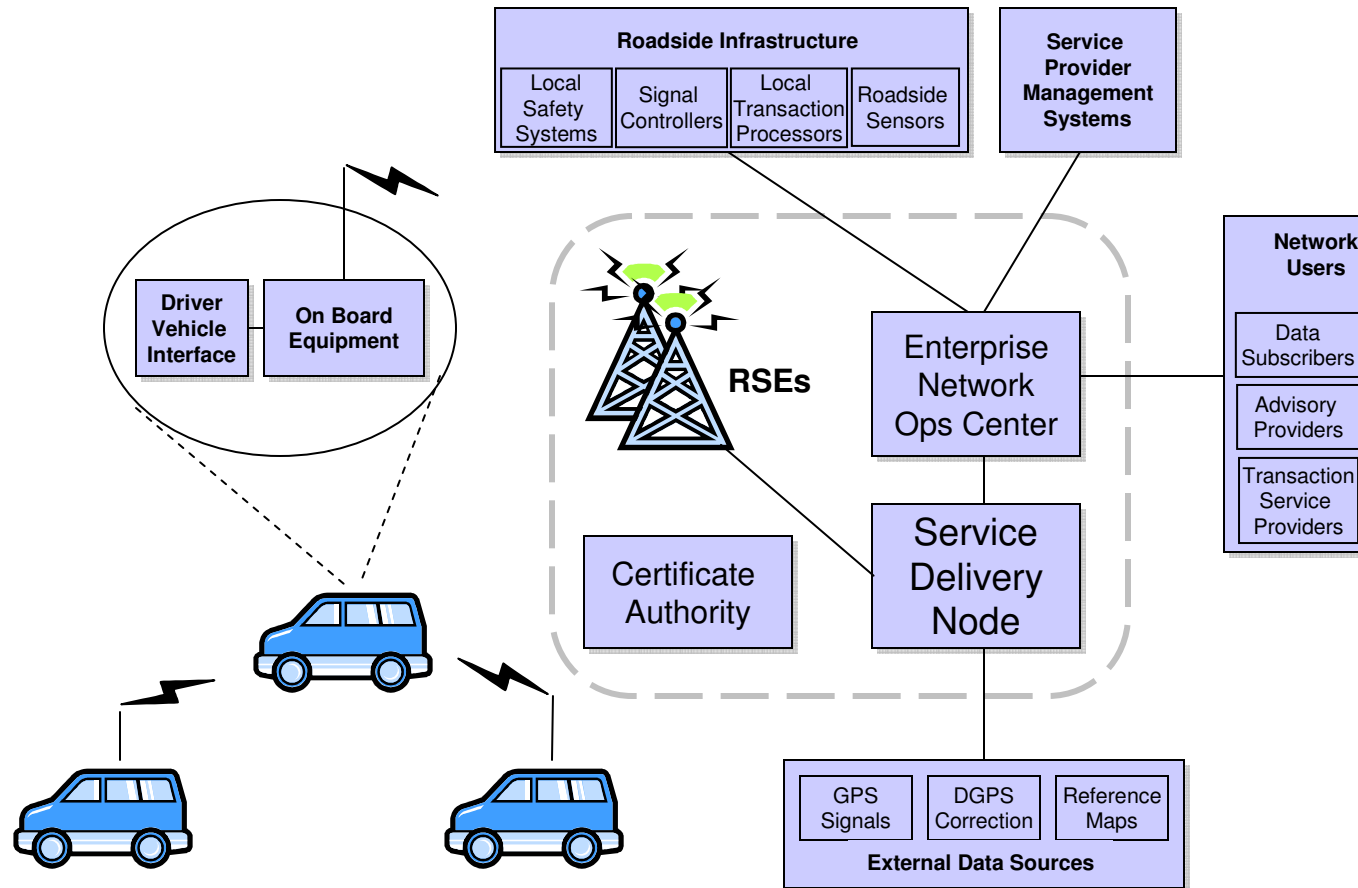
## ▶ Objective

- Validate the VII concept of operations
- Validate that the VII system will support Safety, Mobility and Productivity / Convenience.
- Satisfy majority of the technical viability decision criteria

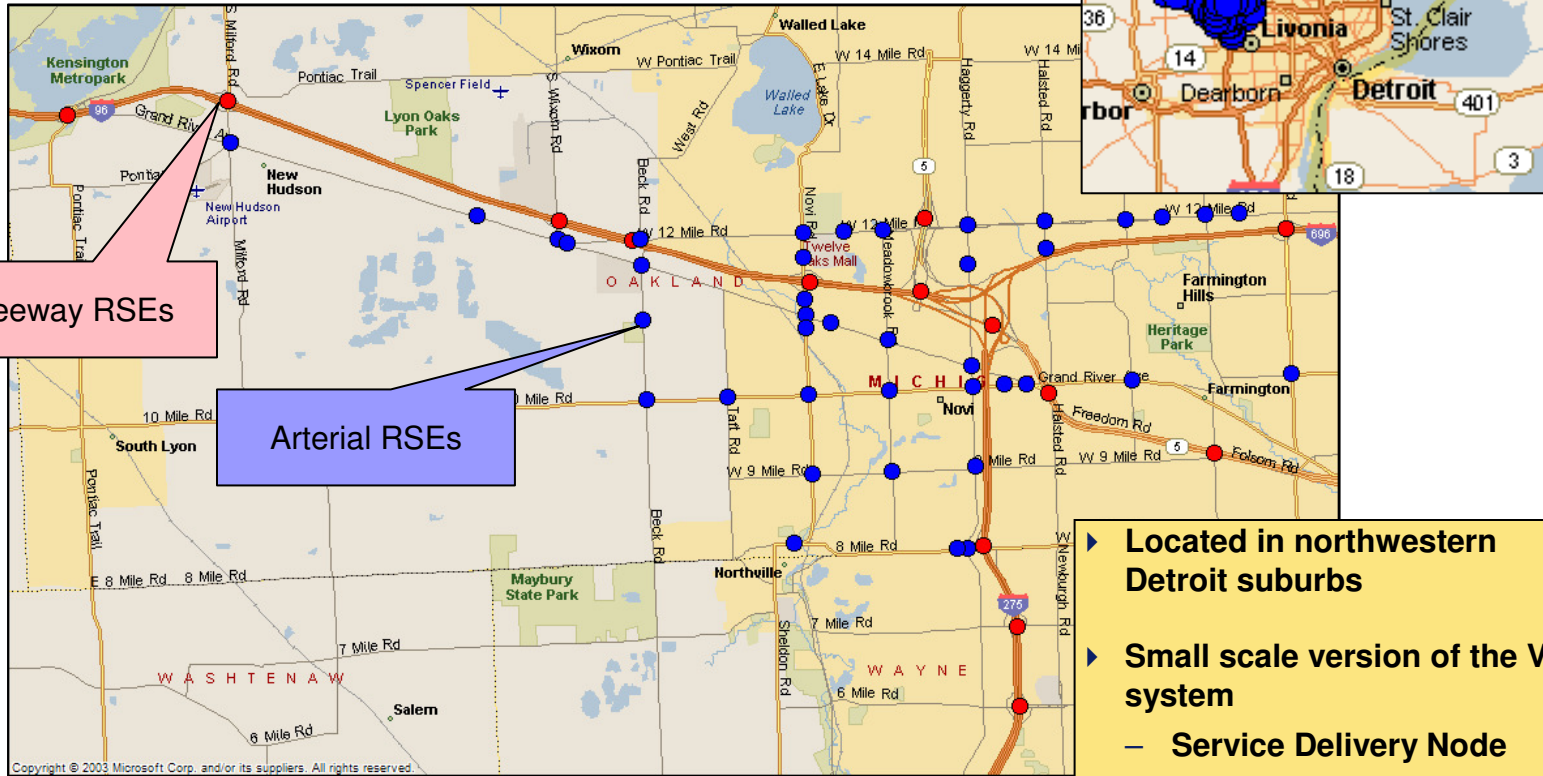
## ▶ Approach

- Conduct structured integration tests of the subsystems and their components
- Conduct functional and performance tests of the integrated system
- Conduct functional and performance tests to verify that the system will simultaneously support typical applications of safety, mobility and Productivity / Convenience.

# VII System Architecture



# Development Test Environment (DTE)



Freeway RSEs

Arterial RSEs

- ▶ Located in northwestern Detroit suburbs
- ▶ Small scale version of the VII system
  - Service Delivery Node
  - 55 RSEs
    - 44 at arterial intersections
    - 11 on freeways
  - 45 sq miles
  - 75 road centerline miles

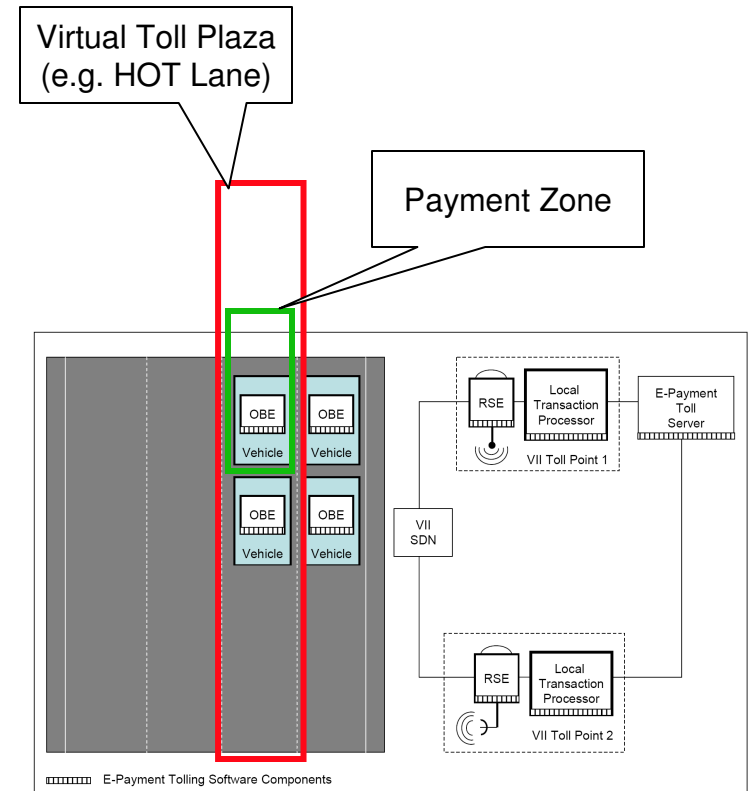
# E-Payment Tolling Application

## Description:

- Toll transactions are conducted between in-vehicle and roadside components as vehicles travel at high speed through designated VII Tolling Zones.
  - Digital certificates and signatures are used to authorize payments and verify payment confirmations.
  - All transaction data exchanged is encrypted.
- Demonstrates that lane based payments are feasible using basic VII functions

## Test Acceptance Criteria

- For vehicles in tolled lanes, correct toll transactions are completed and the correct user accounts are debited
- For vehicles in the free lanes, no toll transactions are observed.



# Tolling Test Setup (Michigan DTE)



- ▶ Plaza area
  - 10 payment zones
  - High-speed/Low-speed
  - Lane specific payment zones



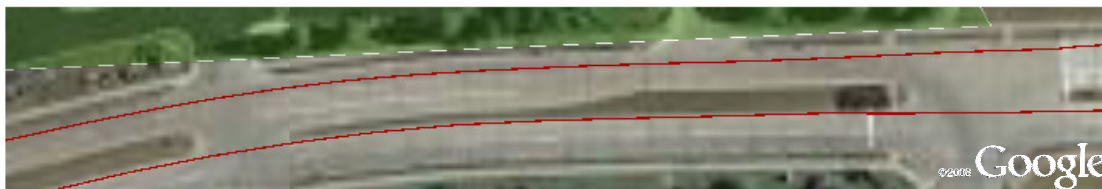
# Typical Performance Examples



Discrimination between roads in plaza zone and not in plaza zone



Zone exit and re-entry without double charging



Discrimination of nearby adjacent roads without charging

# California Toll Tests

- ▶ Performed at Dumbarton Bridge in SF Bay area
- ▶ Same basic operational approach as Michigan tests
- ▶ Exhibited good performance, except for shadowing from toll plaza camera gantry
  - Gantry substantially affected RF performance
  - Transactions still underway as car passed under gantry were not completed





# Technical Findings

- ▶ DSRC based tolling worked well:
  - Able to discriminate lane based payment zones
  - Able to execute transactions at high speed
  - Able to avoid charging users not in payment zones
  - Correctly executed true positives and negatives
  - Physical obstructions caused some missed payments