



Intelligent Transportation Systems Modeling and Analysis Framework for the GCM Corridor

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ITS Program

February 16, 1999



Motivations: Using ITS technologies, perhaps we can...

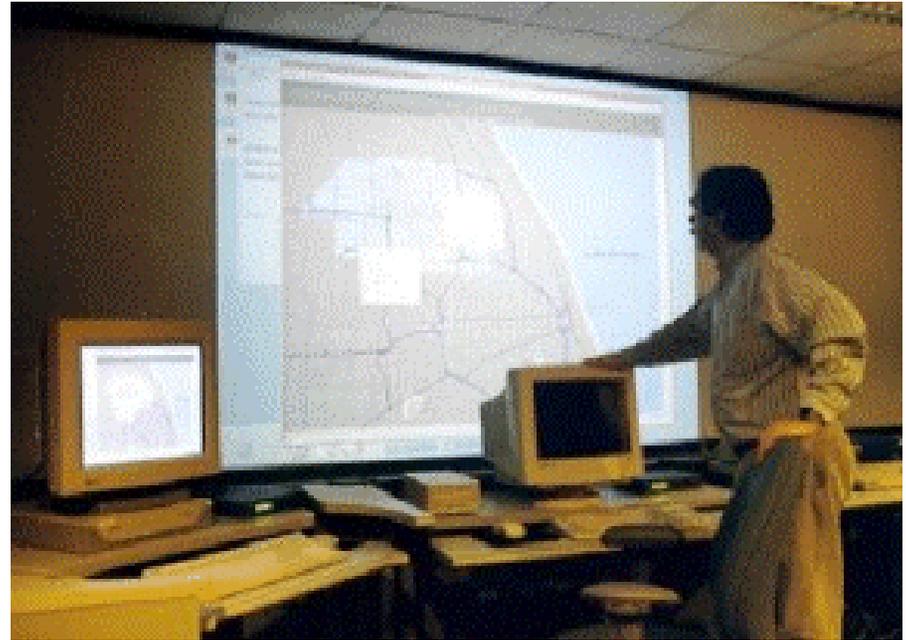
- Improve safety
- Reduce energy consumption
- Reduce environmental impacts
- Improve productivity





Why Simulate?

- Mathematically model the behavior of a system to:
 - Replace expensive or risky experiments
 - Training/education
 - Analysis and evaluation
 - Design
 - Decision support



*Argonne ITS Modeling and
Analysis Framework*



Requirements

- Distributed, scaleable architecture (to support large problems on networks of computers)
- Modular framework supporting plug-in models, hardware, and live data sources

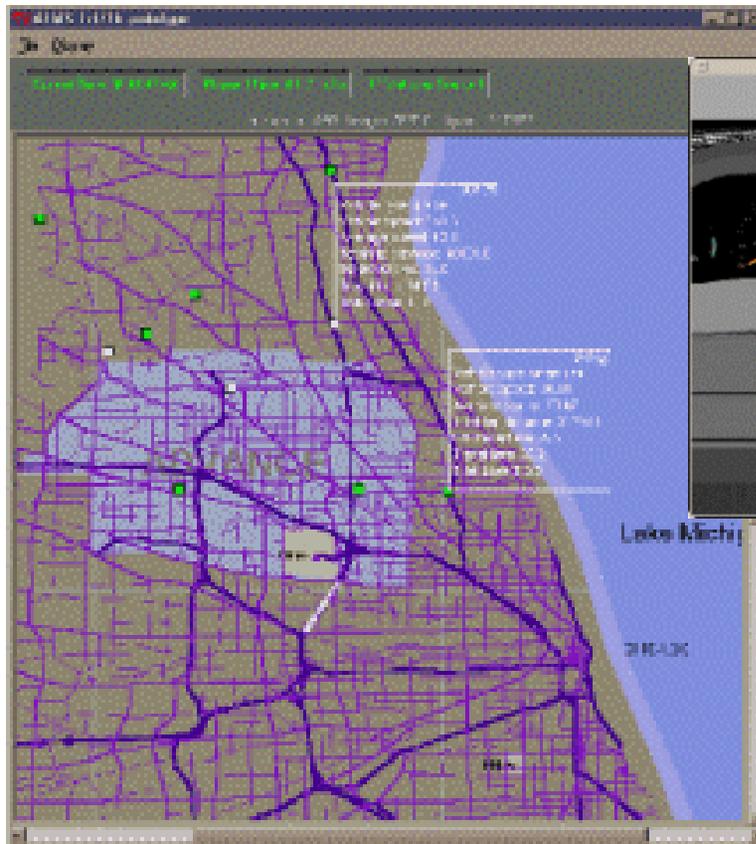


*Argonne's 98-Node IBM SP
48-GFLOP performance*



Requirements

- Visually realistic graphics displays

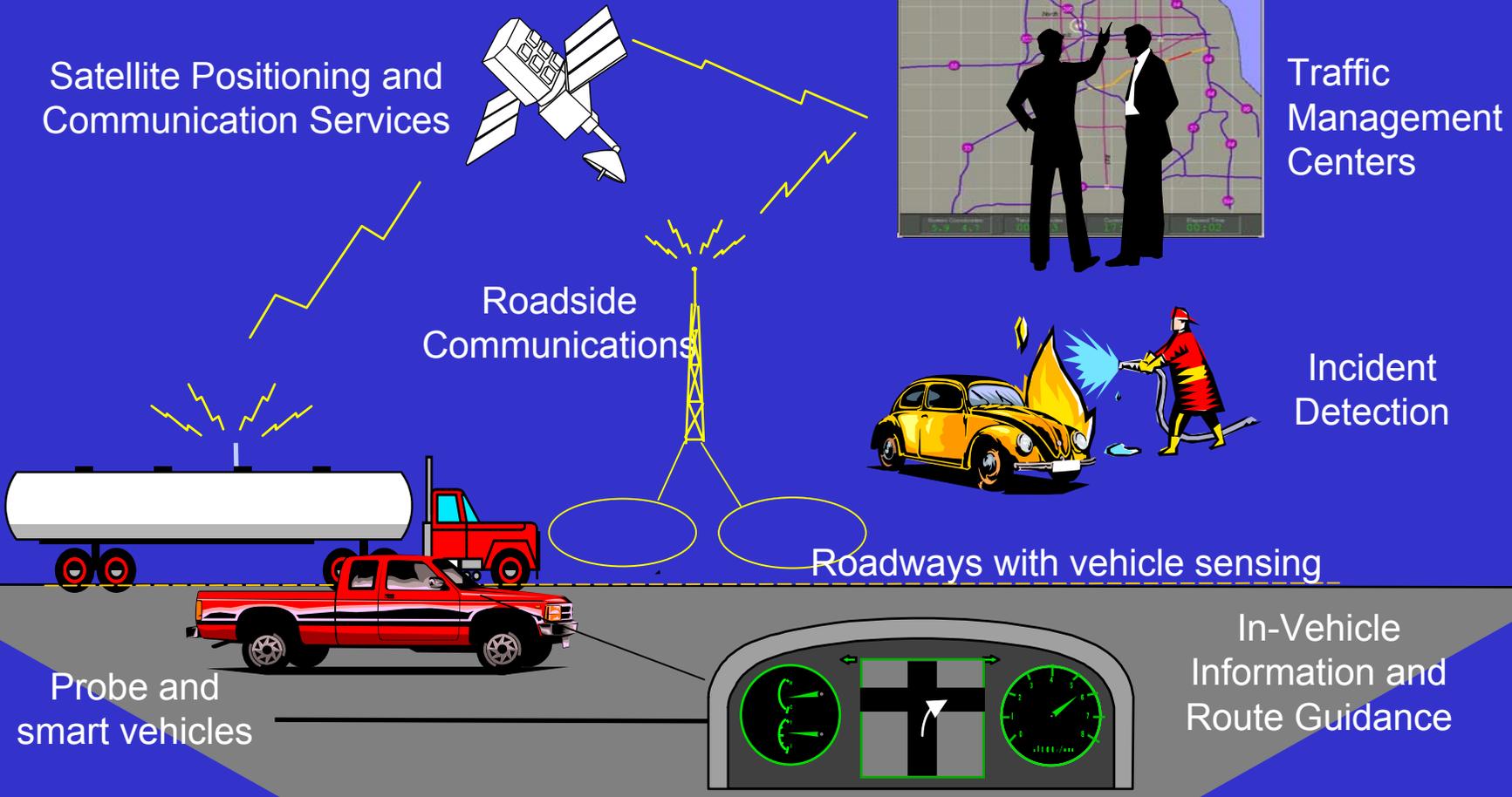


*Traffic
Management
Center GUI*





• Models for basic ITS elements





Traffic Center GUI

Scenario Generator

Traffic Congestion

Scenario Generator

Quit

Scenarios

3 vehicle test
Rt 55 accident
Clear congestion

Start

Comm interval (sec): 5 1 100

Real time factor: 1 1 10

Vehicle type: Non-instrumented Car Emergency Truck/Bus

Route strategy: Min distance Min time Min fuel Min noise Global opt

Driver behavior: Normal Aggressive Conservative

Set Origin Set Dest

Links

394
R83
R45
Harlem
Cicero
Ogden

Intersections

80
R83
55
Ogden
Roosevelt
290

Start

Ogden & Harlem to Harlem & R83

ATMS Tcl/Tk prototype

File Display

Current Time: 10:40:42 AM

Elapsed Time: 10:7:31

10 Vehicles Tracked

Link name: I-294 Length: 7625.0 Speed: 24.5872

Vehicle type: probe
Vehicle speed: 15.65
Average speed: 15.11
Total trip distance: 30831.0
Est travel time: 34.01
Travel time: 34.01
Time saved: 0.0

Vehicle type: smart car
Vehicle speed: 15.65
Average speed: 20.67
Total trip distance: 31251.0
Est travel time: 25.2
Travel time: 25.2
Time saved: 0.0

Lake Michigan

CHICAGO

Midway

Harlem

Traffic Management Center

- Tracking
- Analysis
- Advisories
- Information

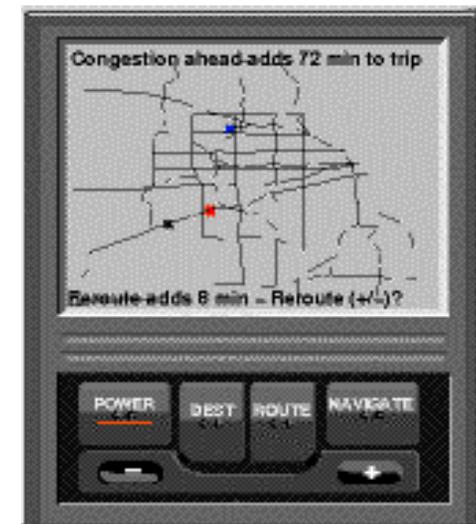


Smart Vehicle GUI



- Route Planning
- Track over map
- Guidance
- Advisories/
alternate routes

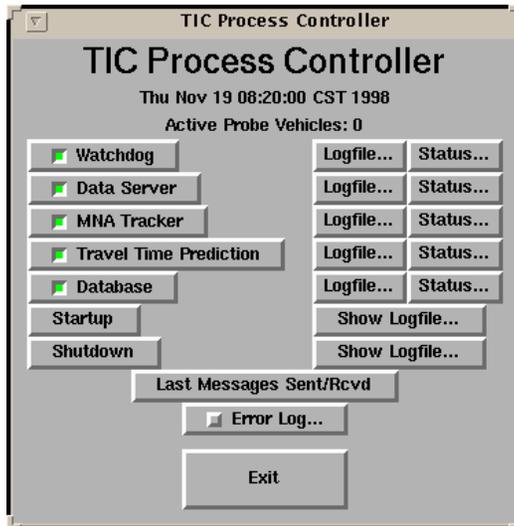
← Directional guidance along optimal route



Congestion advisory and suggested alternate route →

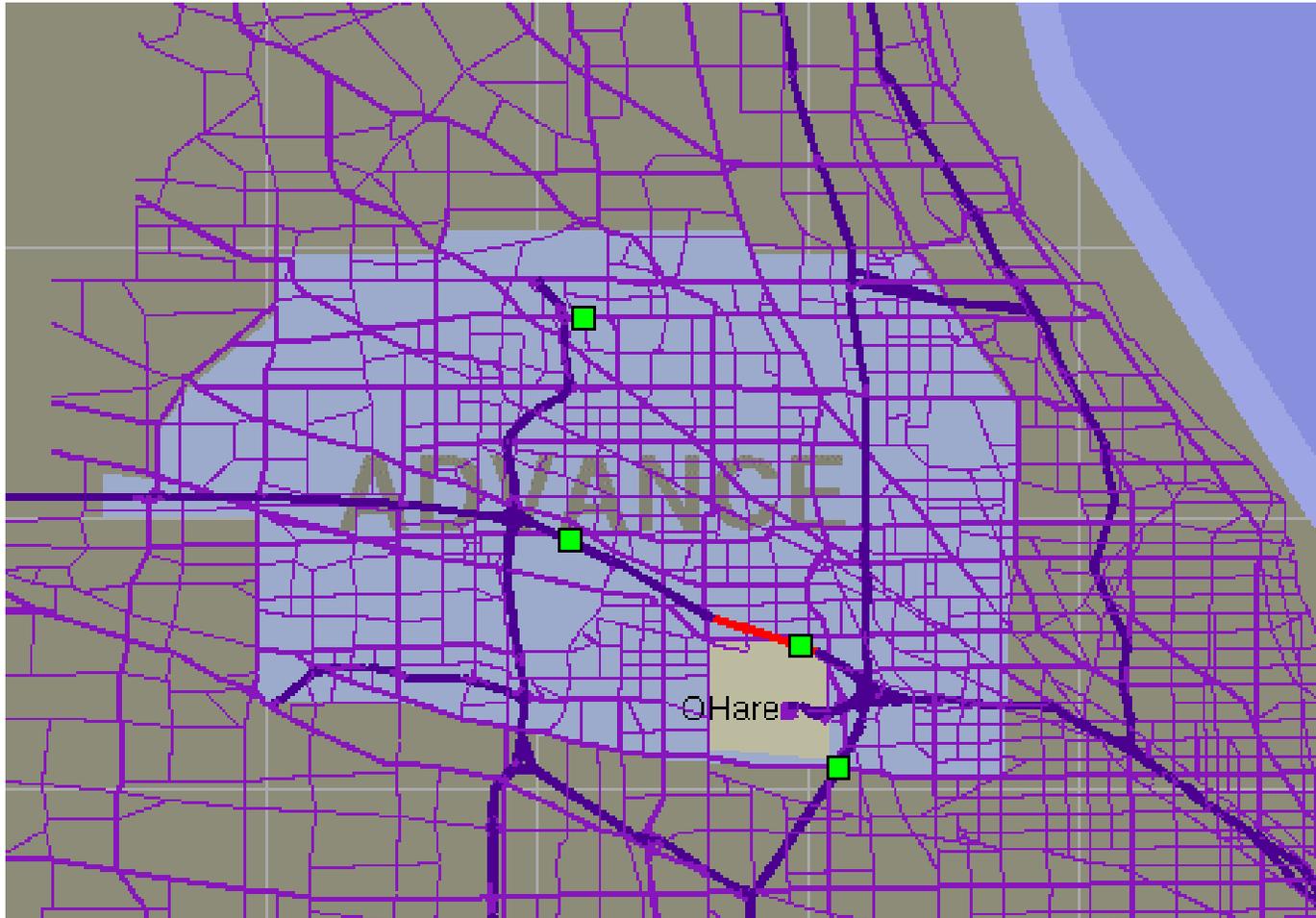


ADVANCE TIC





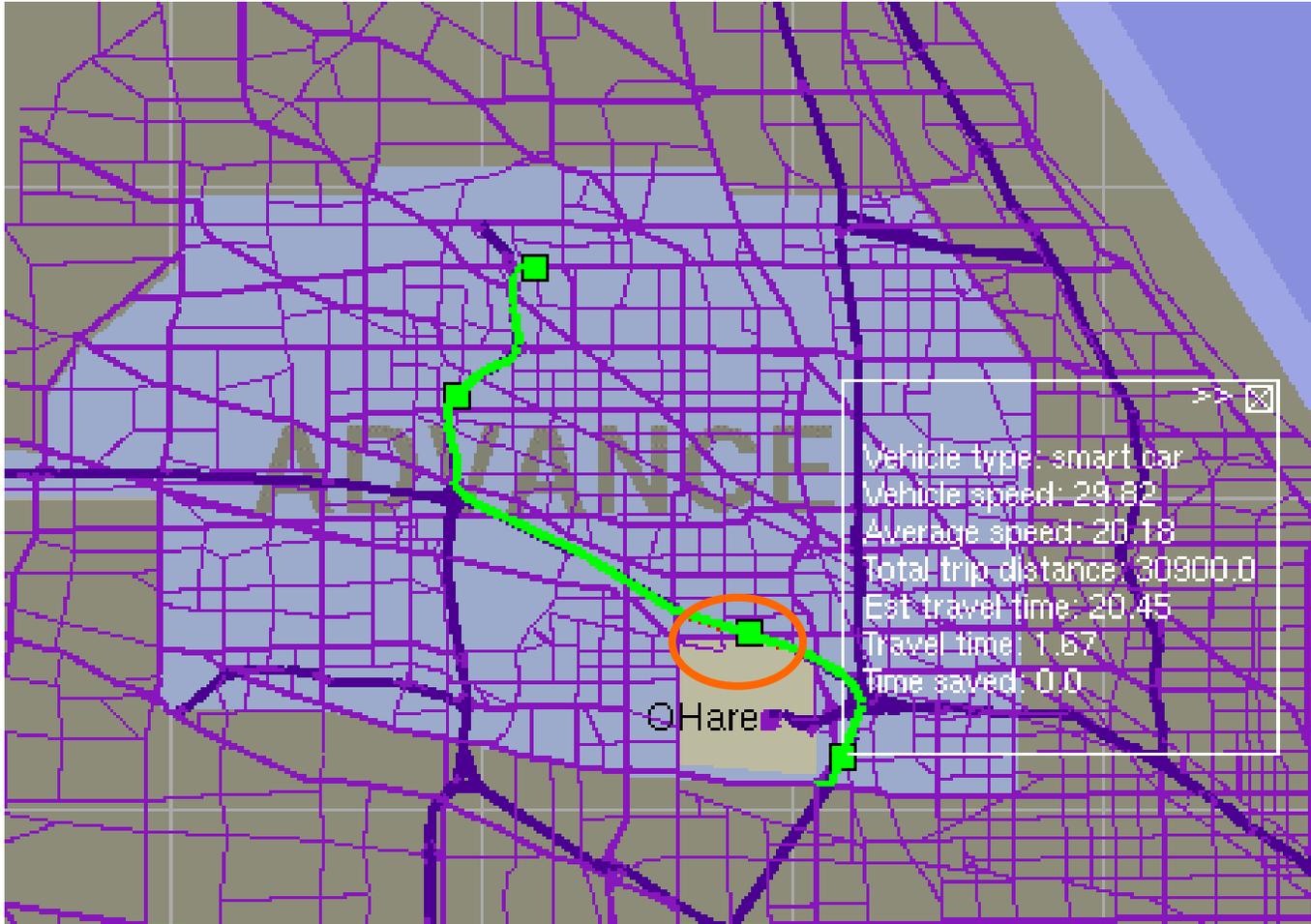
Reroute Example



An accident is simulated by artificially limiting flow along the indicated link.



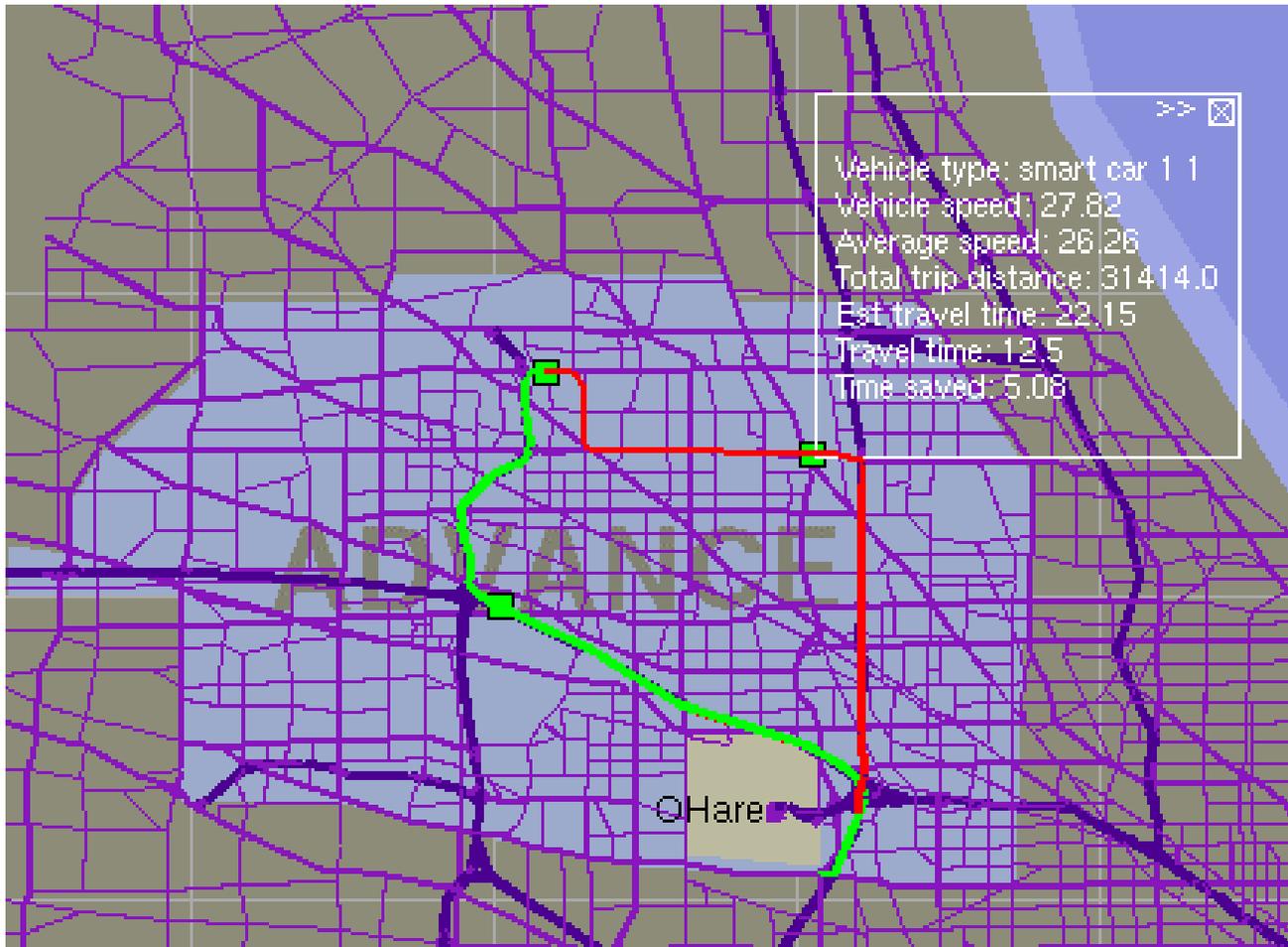
Reroute Example



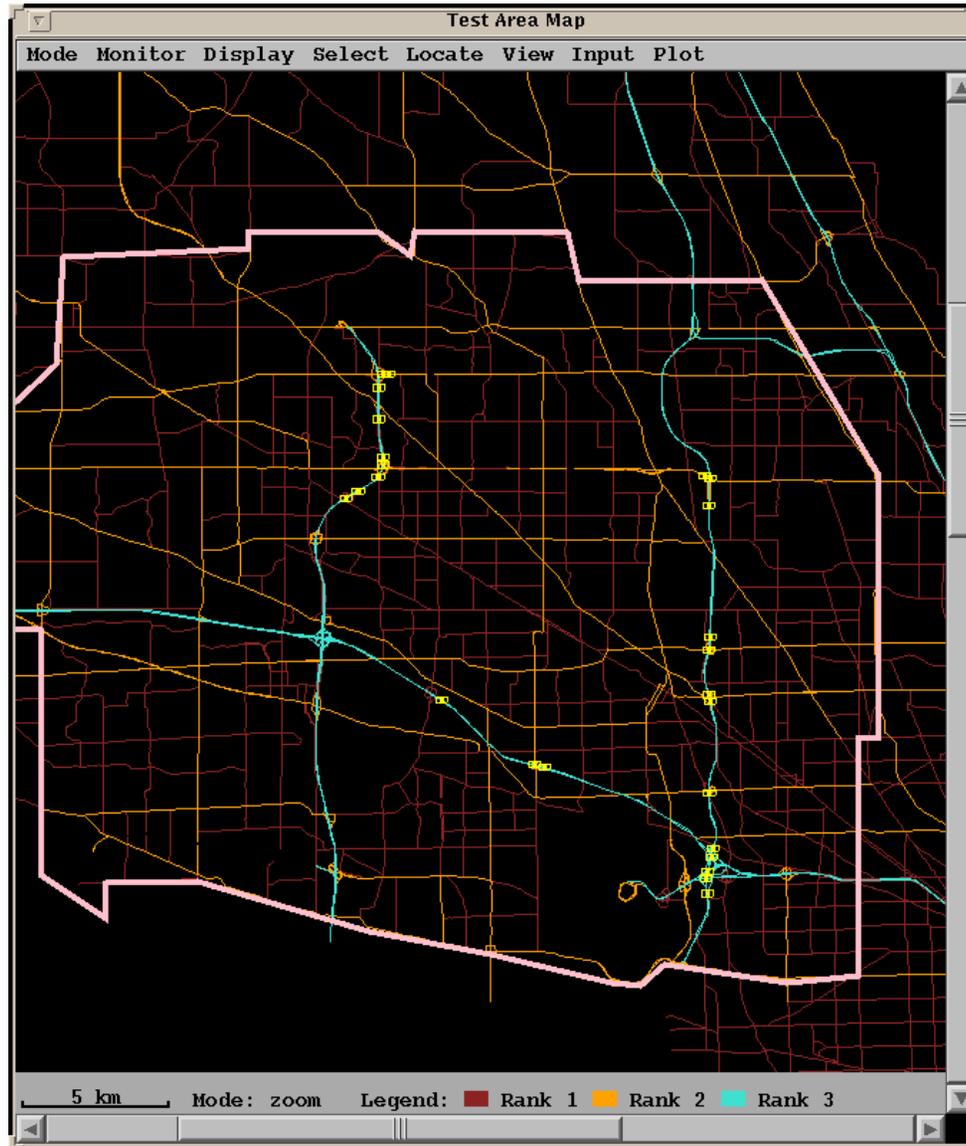
An incident has been detected (circle), and the TIC broadcasts an advisory. The incident is on the original route of travel (green line) of the smart vehicle at lower right.



Reroute Example



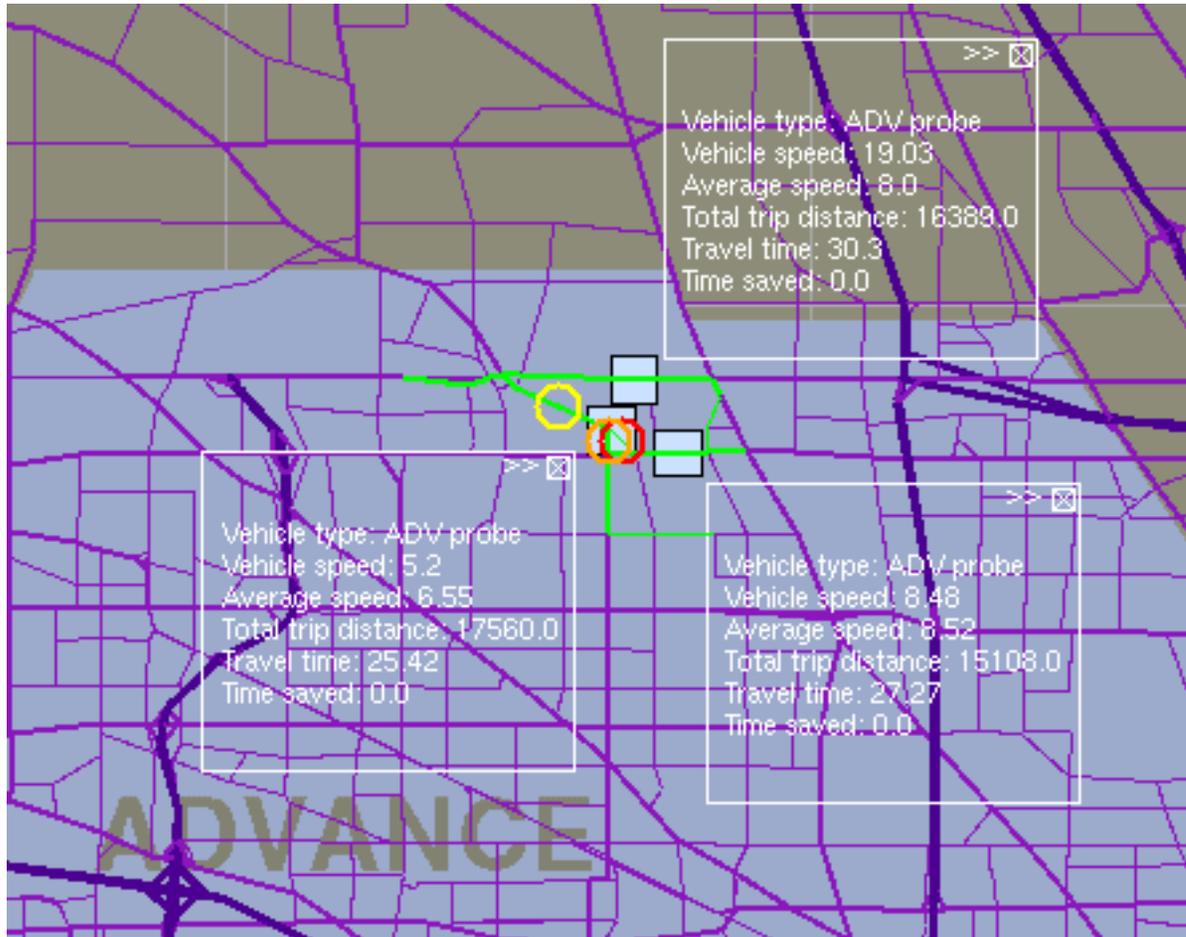
The smart vehicle has rerouted (red line), resulting in a 20% time savings



The TIC reacts to simulated smart vehicles as if they were actual ADVANCE cars.



ADVANCE Experiment: Experiment 2, Yoked Driver Dynamic Vehicle 0D



Origin:
Lake-Cook Rd & Raupp Blvd
Buffalo Grove, IL 60089

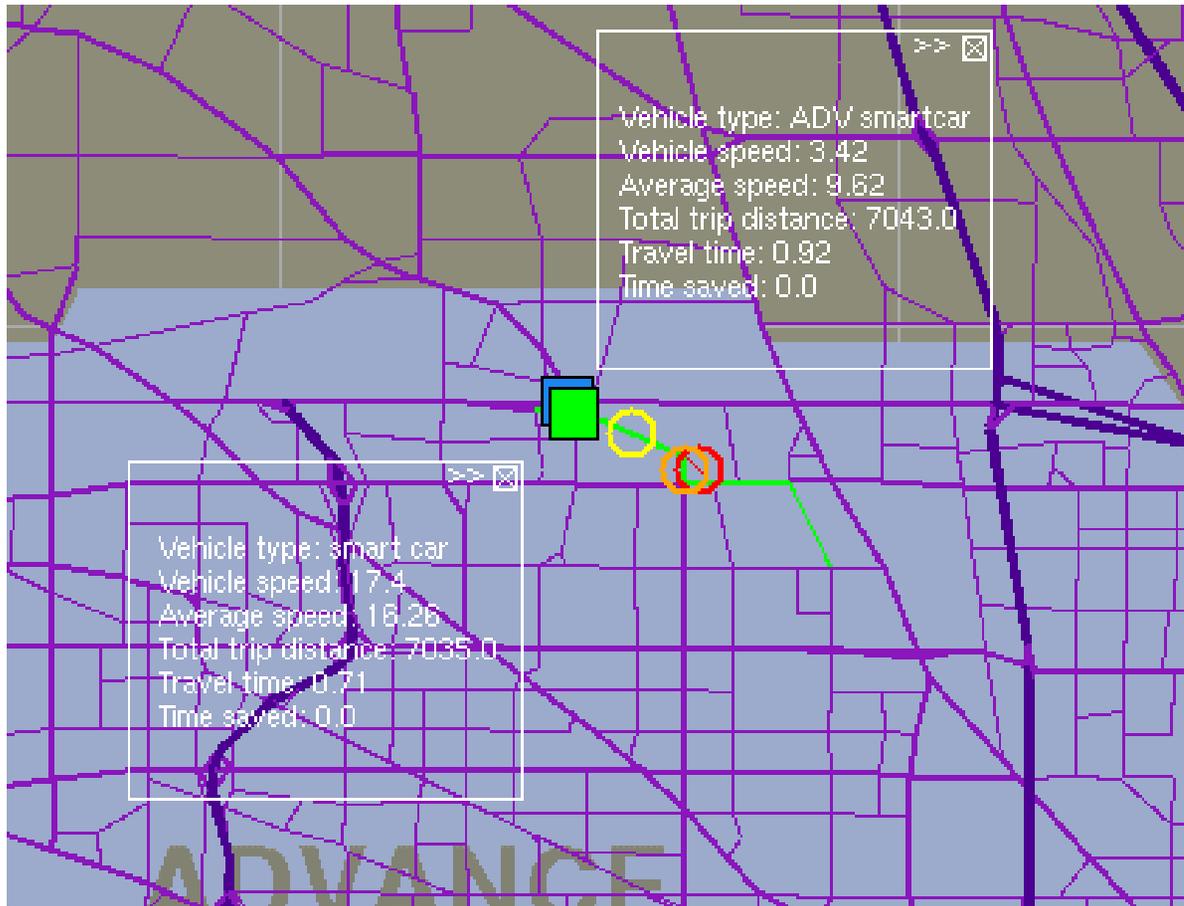
Destination:
Hintz & Wolf Rd
Wheeling, IL 60090

STEP 1: RUN PROBES

- Run ADV probes 11, 9, and 16 in correct time sequence
- TIC reacts to probes; sends advisories



ADVANCE Experiment: Experiment 2, Yoked Driver Dynamic Vehicle 0D



Origin:

**Lake-Cook Rd & Raupp Blvd
Buffalo Grove, IL 60089**

Destination:

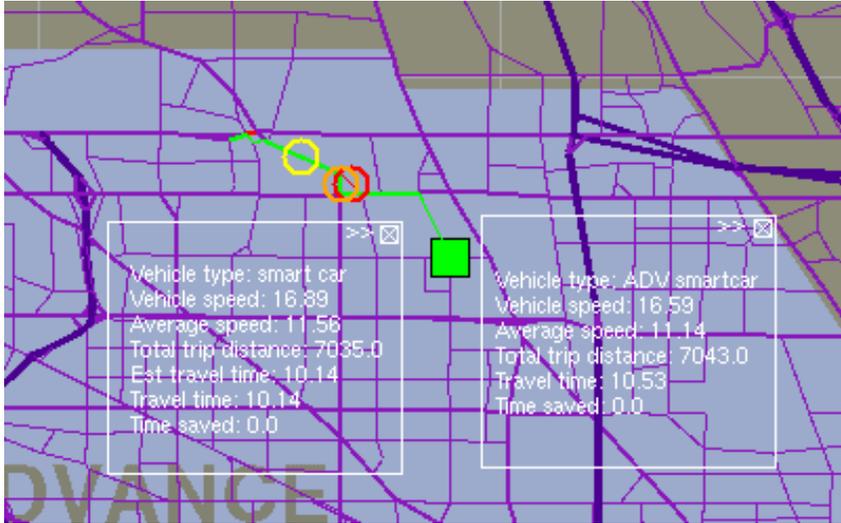
**Hintz & Wolf Rd
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STEP 2: RUN DYNAMIC VEHICLES

- Run ADV smart car 0D and simulated smart car with same origin-destination
- Simulated car sees same TIC advisories as original ADVANCE dynamic car



ADVANCE Experiment: Experiment 2, Yoked Driver Dynamic Vehicle 0D



RESULT

- Simulated smart car chose same route
- Travel times nearly identical

Directions

Distance

East on W LAKE COOK RD

0.4 mi (0.6 km)

Turn RIGHT onto SR-83

1.4 mi (2.2 km)

Turn RIGHT onto Elmhurst

0.3 mi (0.5 km)

Turn LEFT onto W DUNDEE RD.

1.1 mi (1.8 km)

Turn RIGHT onto S WOLF RD.

1.2 mi (1.9 km)

Total Distance:

4.4 mi (7.0 km)

Actual Time (minutes):

10.5 (ADV) / 10.1 (SIM)



Conclusions

- Created distributed, modular framework to support ITS modeling and analysis
- *Information Everywhere* displays go well beyond TIC design; provide useful model for future TMC designs
- Demonstrated coupling of TIC in simulation loop and reuse of legacy components
- Demonstrated capability to re-create/extend ADVANCE-type ITS experiments
- Provided valuable new insights into ADVANCE results
- Created a capability to use ADVANCE data for ITS model validation -- facilitated by ADVANCE Information Source (AIS)
- Created a valuable tool for planning future experiments and deployment activities