Development Of a New Rural Intersection Conflict Warning System: ALERT Project

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Outline

- Introduction
- System description
- Evaluation results
- Conclusion

- **A**dvanced **LE**D Wa**r**ning System for **R**ural In**T**ersections (ALERT)

Intersection Safety Performance in Minnesota

- For the ten years period (2002-2011), 43% of all intersection crashes occurred at unsignalized intersections.
- 65% of fatal and serious injury crashes occurred at unsignalized intersections.
- Rural Two-Way Stop Control intersections accounted for 76% of these crashes.

Other Factors

- Static intersection warning signs appear to be ineffective
- Sight restrictions increase risk of crash (vertical and horizontal curves)
- Limited local funding for major intersection improvements (i.e. realignment, grade corrections)
- Difficult to justify major improvement projects, due to low traffic volumes

System Goals

- Low cost, low maintenance, dynamic interaction warning system based upon presence of traffic
- Effect a reduction in speed for vehicles on the major approach when approaching the intersection
  - System warns driver on the major approach of a vehicle stopped or entering the intersection from the minor approach
- Reduce the probability of a conflict at the intersection between a turning vehicle from the minor approach and a vehicle on the major approach
  - System warns driver on minor approach of an approaching vehicle on the major approach

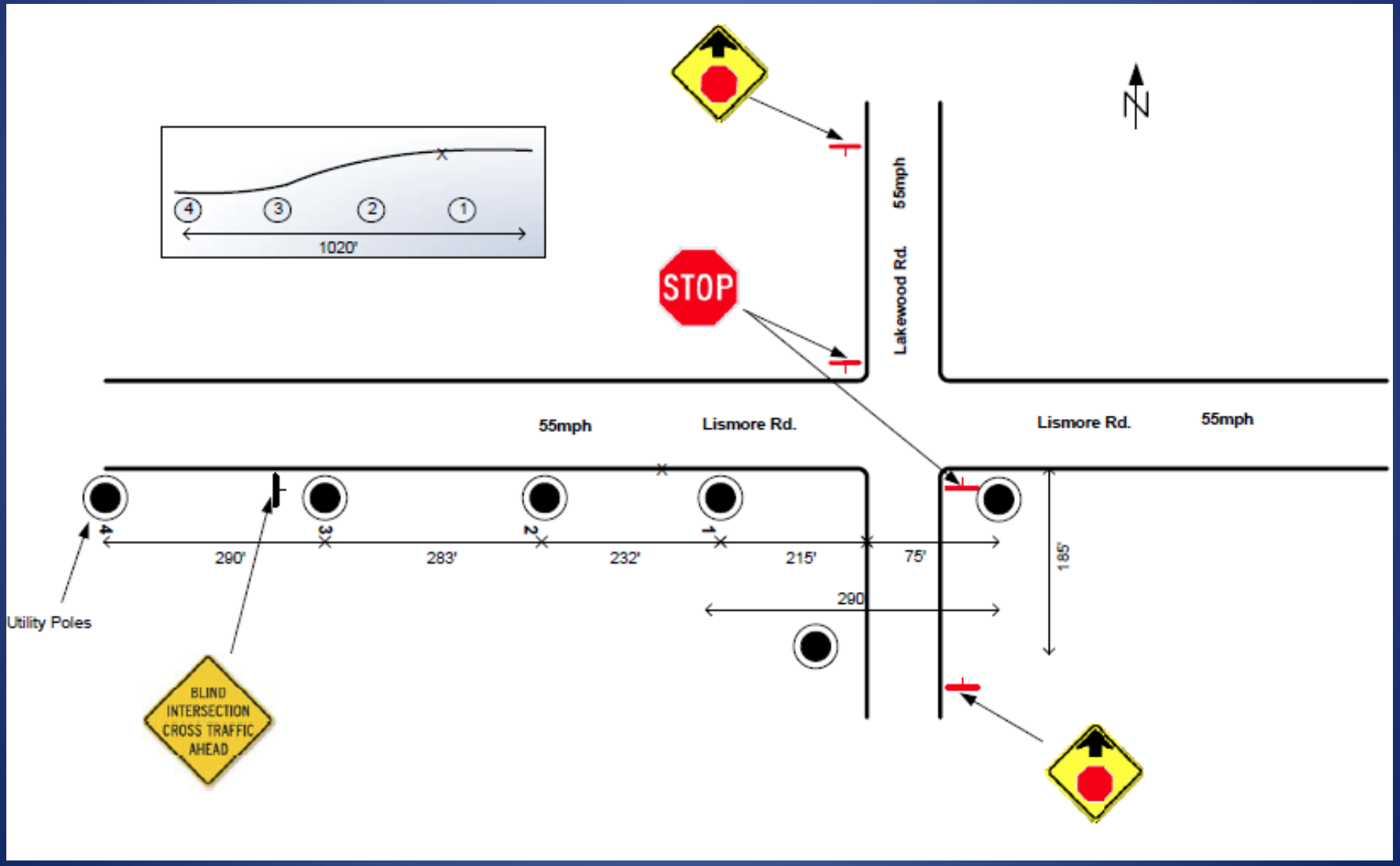
System Design Approach

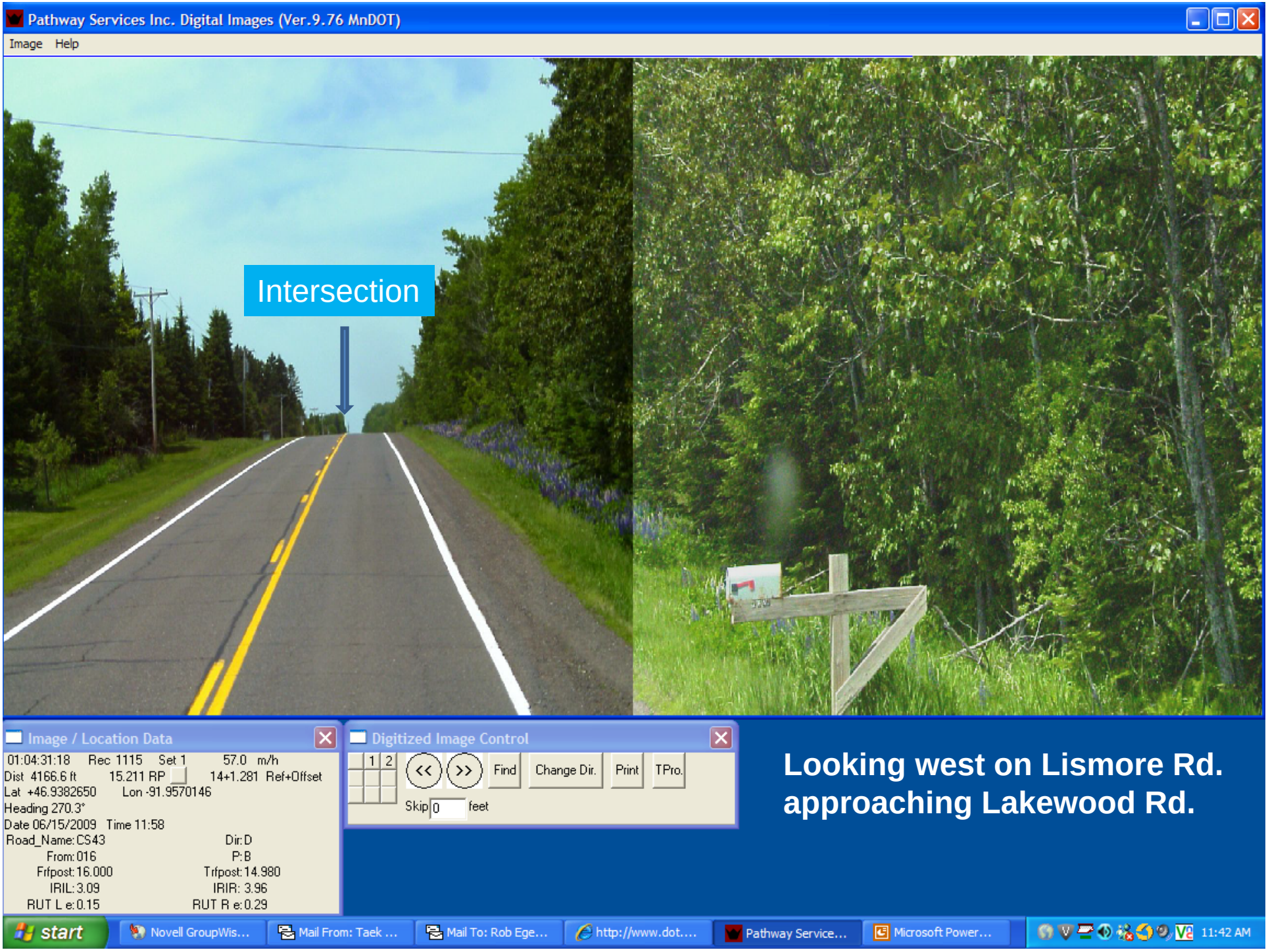
- System will utilize existing “off-the-shelf” technologies
- Can be assembled by traffic/sign technicians
- Wireless communications between components; no “hardwire connections”; no conduits
- Nonintrusive vehicle detection (e.g. radar)
- Utilize alternative energy source (solar) and avoid AC
- Utilize LED blinker signs

ALERT Projects

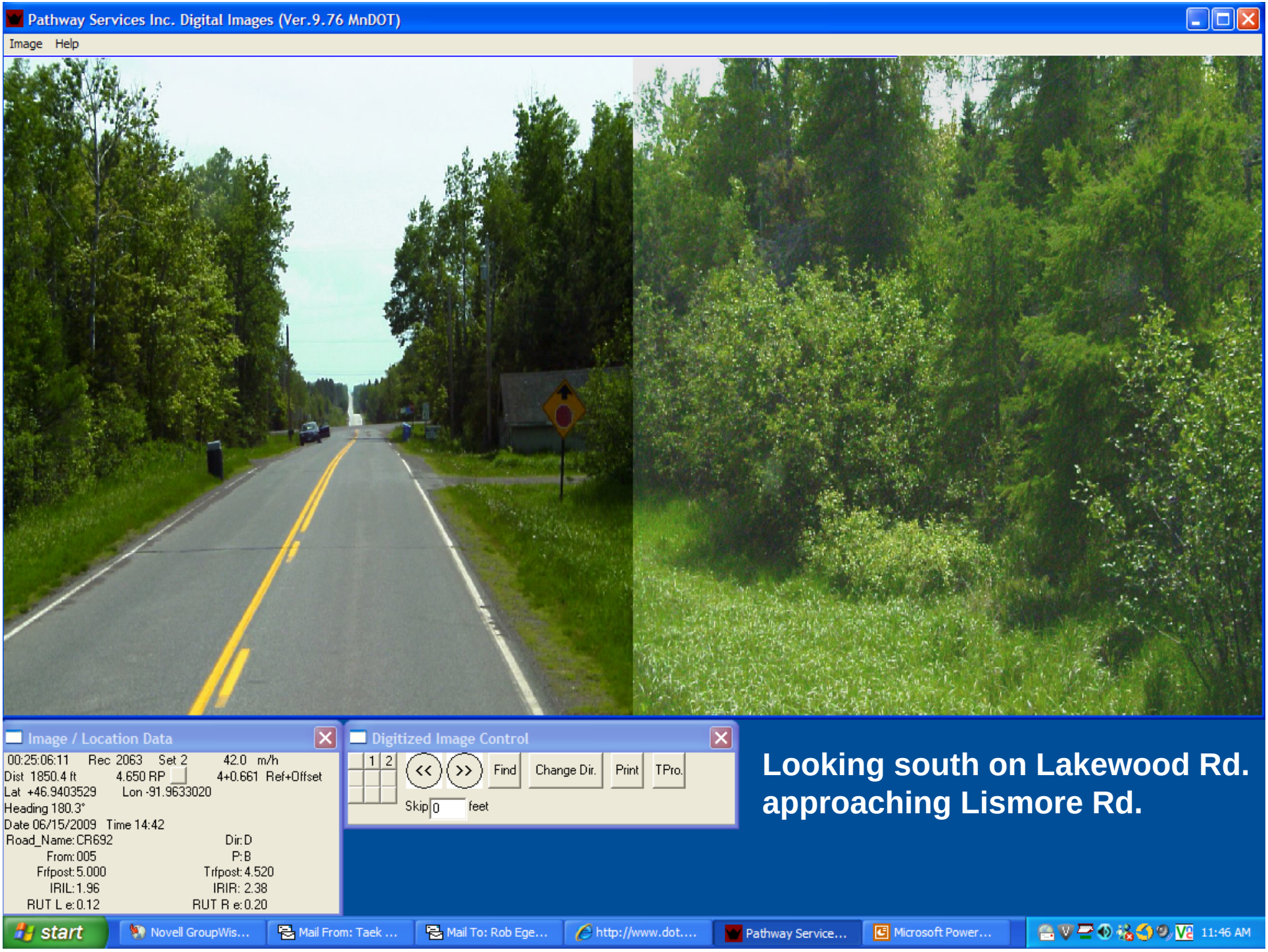
- Funds were provided by the Minnesota Local Road Research Board (LRRB)
- ALERT-1
  - Started Feb 14, 2008
  - Ended Feb 28, 2011
  - Intersection: Eagle Lake Rd/West Tischer Rd, Duluth MN
- ALERT-2
  - Started Dec 14, 2011
  - Ended Jun 30, 2014
  - Intersection: Lismore Rd/Lakewood Rd, Duluth MN

Lismore/Lakewood Rd Intersection





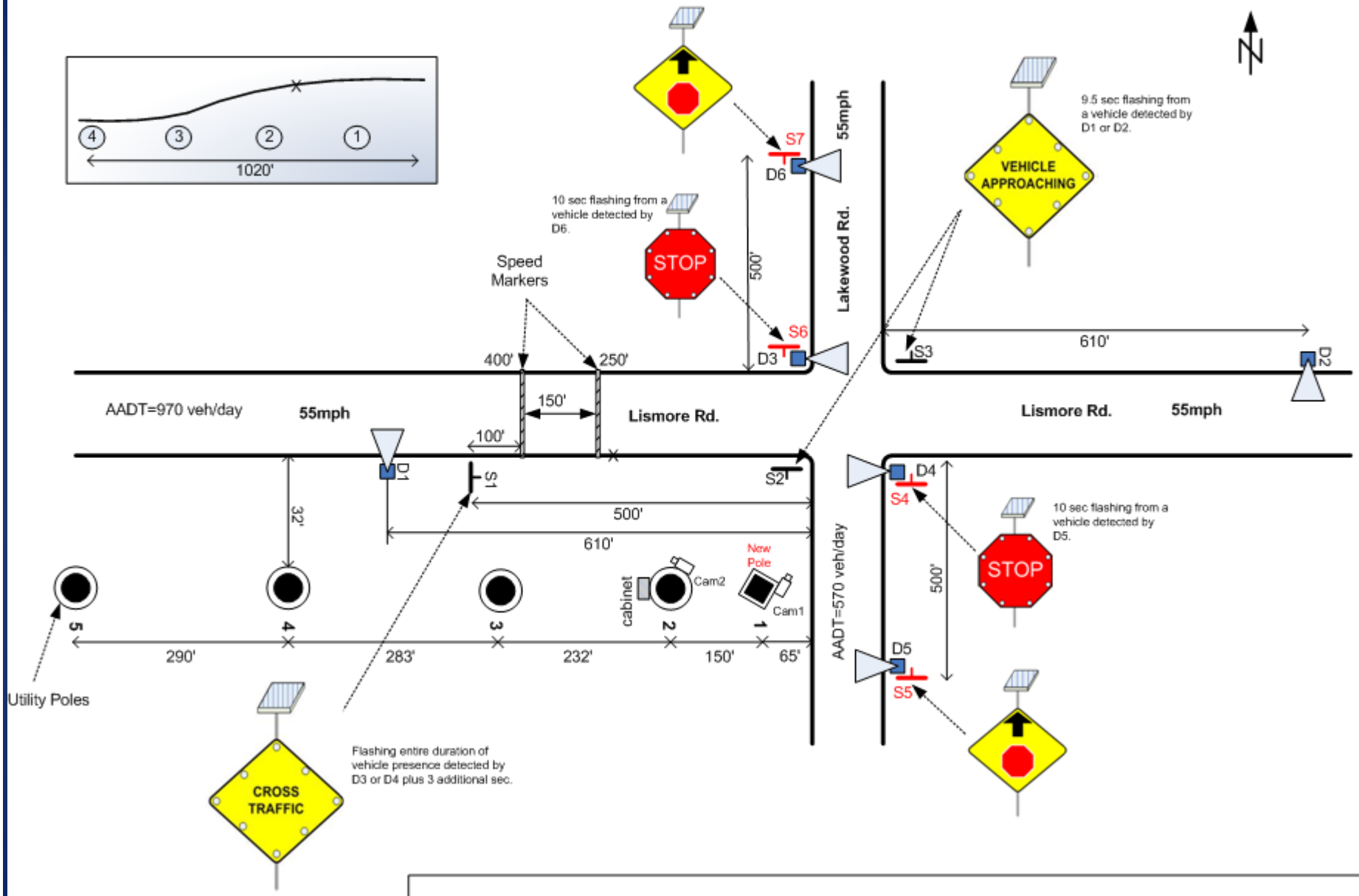
Looking west on Lismore Rd. approaching Lakewood Rd.



Looking south on Lakewood Rd. approaching Lismore Rd.

ALERT-2 Installation:
Lismore Rd/Lakewood Rd Intersection

9/6/2012



Using the posted speed limit = 55 MPH:

- Minimum advance placement distance for major road warning sign = 320 ft (MN MUTCD Table 2c-4)
- Passenger vehicle time gap (tg) for case B1-left turn from minor road = 7.5 sec (AASHTO Gr Book Table 9-5)


Burchfiel's
Greenhouses
2
43
STOP


STOP
VEHICLE
APPROACHING
ADOPT A HIGHWAY
NEXT 2 MILES
Chad & Heidi Frantz
Family & Friends
ST. LOUIS
692
COUNTY
LISMORE RD
LAKEWOOD RD

Data Collection

- Two network video cameras (PoE) and one server
- Event data logger (records signal changes)
- Mail-in survey within a two mile radius of the study intersection

Video Data Collection

Lismore Road

Intersection

Battery Power

Signs with a Radar Detector

	ALERT-1	ALERT-2
Average Daily Power Demand	26Wh	36Wh
Battery Capacity	106Wh	2,688Wh
Days of Storage Without Charge	7 days	25 days
Solar Panel	20W	20W

Signs without a Radar Detector

	ALERT-1	ALERT-2
Average Daily Power Demand	8Wh	7.8Wh
Battery Capacity	67Wh	1248Wh
Days of Storage Without Charge	7 days	45 days
Solar Panel	14W	20W

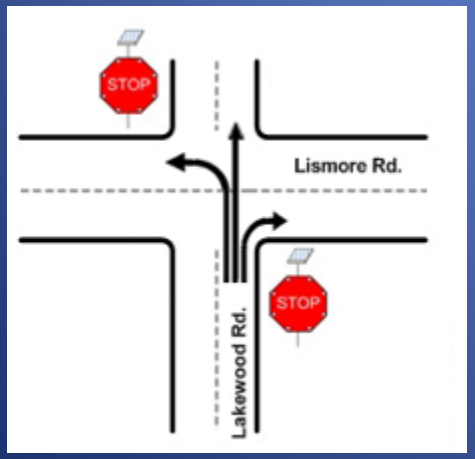
Average Conflict/No-Conflict Speed Difference on the Major Road After Installation of the ALERT-2 System

	No-Conflict	Conflict
Peak Time	51.63 mph	**47.7 mph**
Off Peak Time	51.88 mph	**48.06 mph**
Weekday	51.71 mph	**47.89 mph**
Weekend	51.97 mph	**48.31 mph**
September 2012	52.02 mph	**49.10 mph**
October 2012	51.54 mph	**48.29 mph**
November 2012	52.62 mph	**47.93 mph**
December 2012	51.12 mph	**46.51 mph**
January 2013	50.85 mph	**46.62 mph**
February 2013	51.53 mph	**47.71 mph**
March 2013	51.66 mph	**48.1 mph**
April 2013	51.06 mph	**47.31 mph**
May 2013	51.7 mph	**48.19 mph**
June 2013	**52.29 mph**	**48.18 mph**

Average Speed Decrease: 3.89 mph or 0.93 sec extra time

Roll-Through Percentage of Before and After Installation of ALERT-2

	Before Installation Percent of Roll-throughs	After Installation Percent of Roll-throughs
Right-turn	16.45 %	9.93 %
Through	13.29 %	2.89 %
Left-turn	8.63 %	5.18 %
All turns combined	28.15 %	14.27 %



Roll-Through Percentage of Conflict and no-Conflict Case After Installation of ALERT-2

	Percent of Roll-Throughs Under no-Conflict	Percent of Roll-Throughs Under Conflict
Right-turn	8.7 %	0.76 %
Through	2.78 %	0.19 %
Left-turn	4.74 %	0.21 %
All turns combined	16.22 %	1.16 %

Mail-in Survey on Residents Living in Two Mile Radius

Statement	Strongly Agree	Agree	Total Positive	Disagree	Strongly Disagree	Total Negative
The warning system is easy to understand.	55%	39%	**94%**	5%	1%	**6%**
The warning system improved the safety of the intersection.	56%	36%	**92%**	1%	7%	**8%**
The vehicle activated Blinker STOP signs obtain my attention.	70%	28%	**98%**	1%	1%	**2%**
The warning system could be used at other intersections.	53%	38%	**91%**	5%	4%	**9%**

Another System In Minnesota

- Rural Intersection Conflict Warning System (RICWC)
- Uses AC power and loop detectors
- Uses a traditional traffic controller to control warning signals
- Uses single lens flashing beacon
- $100,000 per system
- Suited for urban intersections

Conclusions

- Reduced vehicle speeds on the main approach by average 3.89mph
- Increased wait time on the minor approaches by about 4 seconds
- Nearly zero roll-throughs on conflict cases
- 92% of survey responses agree or strongly agree that the system improved safety

Future Studies

- Drivers are still treating LED blinking warning signs as traffic signals (cause of roll-throughs)
- Design challenges for battery charge when sunny areas are unavailable in the intersection
- Plug-and-play control circuit, not requiring any programming

Questions?