

Final Research Report
Contract T1803, Task 8
ITS Backbone Infrastructure

A Brief Report on 2001 Activities for ITS Backbone Infrastructure

by

Daniel J. Dailey
ITS Research Program
College of Engineering, Box 352500
University of Washington
Seattle, Washington 98195-2500

Washington State Transportation Center (TRAC)
University of Washington, Box 354802
University District Building, Suite 535
1107 N.E. 45th Street
Seattle, Washington 98105-4631

Washington State Department of Transportation
Technical Monitor
Pete Briglia
Manager, Advanced Technology Branch

A brief report prepared for

Research Office
Planning and Programming Service Center
Washington State Department of Transportation
Transportation Building, MS: 7370
Olympia, Washington 98504-7370

March 2002

TECHNICAL REPORT STANDARD TITLE PAGE

1. REPORT NO. WA-RD 543.1	2. GOVERNMENT ACCESSION NO.	3. RECIPIENT'S CATALOG NO.	
4. TITLE AND SUBTITLE A BRIEF REPORT ON 2001 ACTIVITIES FOR ITS BACKBONE INFRASTRUCTURE		5. REPORT DATE March 2002	
		6. PERFORMING ORGANIZATION CODE	
7. AUTHOR(S) Daniel J. Dailey		8. PERFORMING ORGANIZATION REPORT NO.	
9. PERFORMING ORGANIZATION NAME AND ADDRESS Washington State Transportation Center (TRAC) University of Washington, Box 354802 University District Building; 1107 NE 45th Street, Suite 535 Seattle, Washington 98105-4631		10. WORK UNIT NO.	
		11. CONTRACT OR GRANT NO. Agreement T1803, Task 8	
12. SPONSORING AGENCY NAME AND ADDRESS Research Office Washington State Department of Transportation Transportation Building, MS 47370 Olympia, Washington 98504-7370 Gary Ray, Project Manager, 360-705-7975, rayg@wsdot.wa.gov		13. TYPE OF REPORT AND PERIOD COVERED Research Report	
		14. SPONSORING AGENCY CODE	
15. SUPPLEMENTARY NOTES This study was conducted in cooperation with the U.S. Department of Transportation, Federal Highway Administration.			
16. ABSTRACT <p style="text-align: center;"> The ITS Backbone performs several important tasks for ongoing efforts at the Washington State Department of Transportation and University of Washington. The Backbone (1) supports existing traveler information applications for both traffic and transit information, (2) supports real-time access to WSDOT data for a variety of public and private groups, (3) off-loads the interaction and support of data users external to WSDOT, (4) provides a standard interface so that all roadway data are available equally to outside agencies/groups, (5) supports research activities within WSDOT, research funded by WSDOT at the UW, and research at universities and agencies nationwide, and (6) provides a standard interface to include new data sources into the existing traffic management system. </p>			
17. KEY WORDS Intelligent transportation systems, backbone, real-time data, standard interface		18. DISTRIBUTION STATEMENT No restrictions. This document is available to the public through the National Technical Information Service, Springfield, VA 22616	
19. SECURITY CLASSIF. (of this report) <p style="text-align: center;">None</p>	20. SECURITY CLASSIF. (of this page) <p style="text-align: center;">None</p>	21. NO. OF PAGES	22. PRICE

DISCLAIMER

The contents of this report reflect the views of the authors, who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Washington State Transportation Commission, Department of Transportation, or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

CONTENTS

<i>Section</i>	<i>Page</i>
1 Traveler Information Applications	1
1.1 Transit Applications	1
1.2 Traffic Applications	4
2 Real-Time Data Access	5
3 External Support of Data	6
4 Provision of Standard Interface	6
5 Support of Research.....	6
6 Inclusion of New Data Sources into Existing TMS.....	7
7 End Users of Developed Products	9
8 Work Elements	9

FIGURES

<i>Figure</i>		<i>Page</i>
1	MyBus total page views, January 2001 through February 2002.....	1
2	MyBus usage with Microsoft numbers removed.....	2
3	MyBus WAP phone site usage beginning January 2001	2
4	MyBux Palm usage beginning January 2001.....	3
5	Busview data stream usage for 2001	3
6	Prototype map of real speed data.....	7
7	Virtual speed sensors on the ITS Backbone	8

TABLES

<i>Table</i>		<i>Page</i>
1	Domains that have downloaded TDAD data.....	4
2	Voluntary affiliation identification.....	5

A BRIEF REPORT ON 2001 ACTIVITIES FOR THE ITS BACKBONE

The ITS Backbone performs important tasks for ongoing efforts at the Washington State Department of Transportation (WSDOT) and University of Washington (UW). The Backbone (1) supports existing traveler information applications for both traffic and transit information, (2) supports real-time access to WSDOT data for a variety of public and private groups, (3) off-loads the interaction and support of data users external to WSDOT, (4) provides a standard interface so that all roadway data are available equally to outside groups, (5) supports research activities within WSDOT, research funded by WSDOT at the UW, and research at universities and agencies nationwide, and (6) provides a standard interface to include new data sources into the existing transportation management system. Each of these contributions is detailed with supporting statistics. Any usage by the developers at the UW has been removed from these statistics.

1. TRAVELER INFORMATION APPLICATIONS

The existing suite of traveler information applications that require the use of the ITS Backbone includes both transit and traffic modules.

1.1 Transit Applications

MyBus: There were 24,152,191 uses over the last 12 months, with over twelve million in December 2001, and the usage has an increasing trend, as shown in Figure 1.



Figure 1: MyBus total page views, January 2001 through February 2002.

These uses were from over 19,000 distinct client addresses, including the largest user, Microsoft. The biggest users are the largest regional employers: Microsoft, Boeing, and the University of Washington. The effect of removing the Microsoft numbers from the page views is shown in Figure 2.

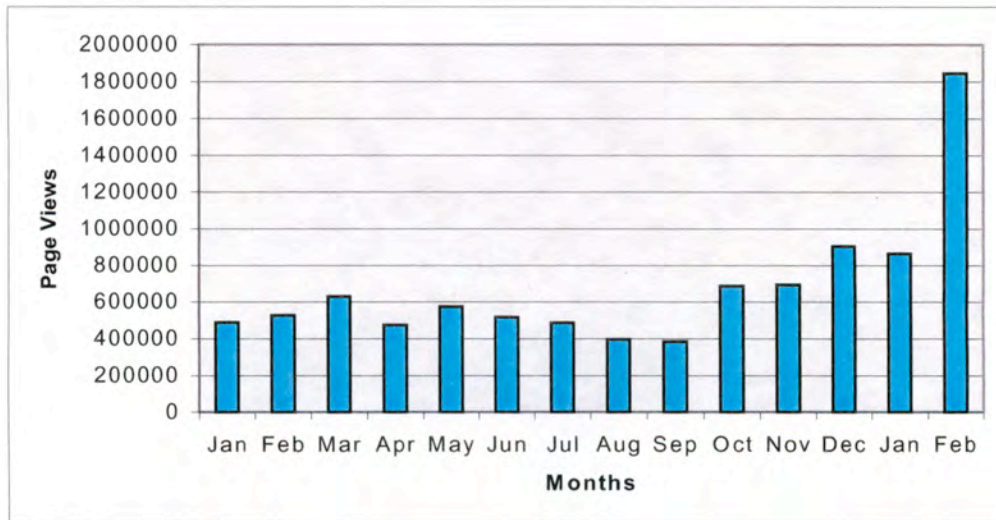


Figure 2: MyBus usage with Microsoft numbers removed.

In addition to the web site, there is the MyBus WAP phone site with usage of about 3,500 per month that is increasing in number, as shown in Figure 3.

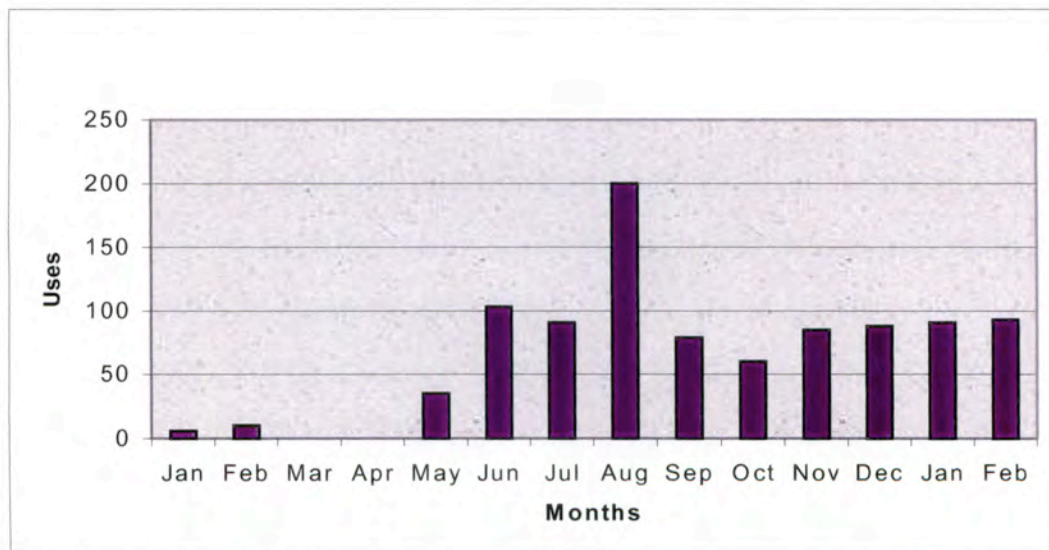


Figure 3: MyBus WAP phone site usage beginning January 2001.

The newest deployment is MyBus for the PALM personal data assistant, which has seen relatively small usage to date, as shown in Figure 4.

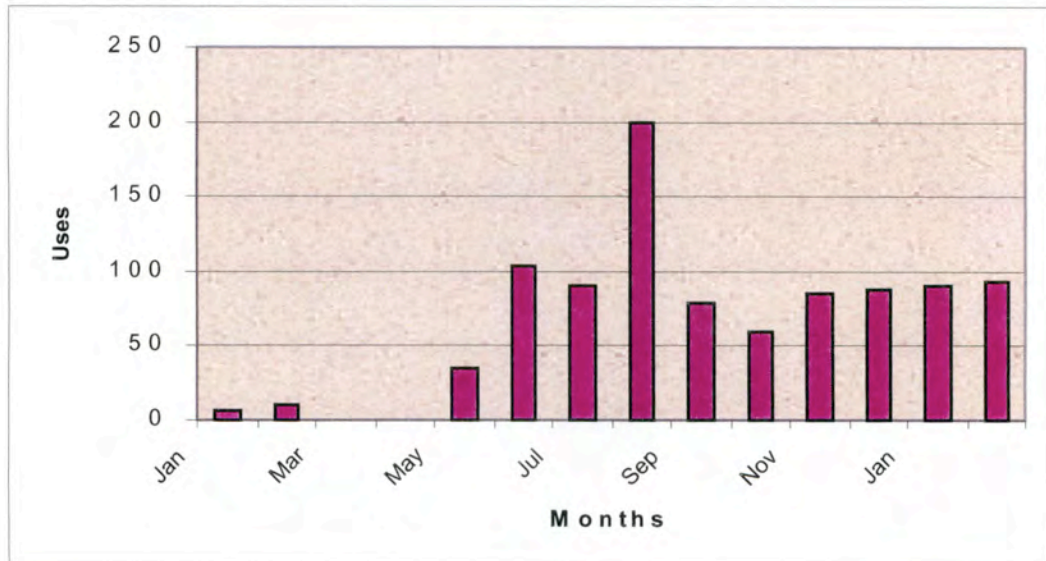


Figure 4: MyBus Palm usage beginning January 2001.

Busview: During 2001 there were 384,141 connections to the data stream that indicated an individual use. Presently, usage is stable at around 10,000 per month but with spikes as high as 84,000 in November. These uses originate from over 33,000 distinct client addresses.

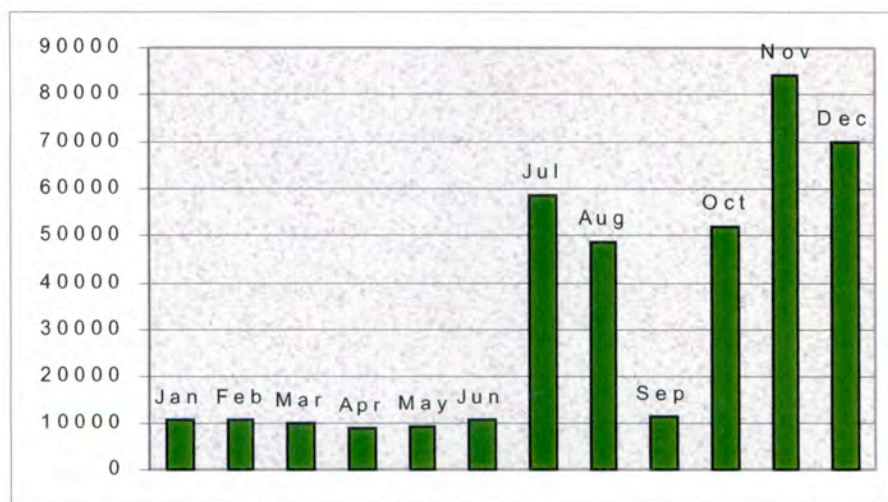


Figure 5: Busview data stream usage for 2001.

Transit Watch: This application has been displayed to thousands of users at both the Northgate and Bellevue Transit centers. All new Sound Transit funded facilities include plans to use Transit Watch.

1.2 Traffic Applications

Trafnet: This application provides speed and travel times and was used 3,743 times from 545 unique hosts.

Traffic Channel: This program is available on UWTV 2 from 1 a.m. to 8:30 a.m., Noon to 2:30 p.m., and 3:30 p.m. to 10:00 p.m. in 200,000 households throughout King County. It is also available on channel 9400 of the Dish 500 Network.

TDAD: TDAD is a datamine that was used 1,689 times by 96 different client addresses from the domains shown in Table 1.

Table 1: Domains that have downloaded TDAD data

accessone.com	adobe.com	andrew.eng.uci.edu
atl1.da.uu.net	benchmark.com	boeing.com
capnet.state.tx	ce.washington.edu	ch2m.com
city.oshawa.on	clientes.euskaltel.es	co.clark.wa
consultec-llc.com	coventry.ac.uk	cpsrta.org
daimlerChrysler.COM	deainc.com	dhcp.pdx.edu
dot.state.oh	dsl.gtei.net	ecom.unimelb.edu
ed.ornl.gov	ee.washington.edu	eecs.umich.edu
eng.uci.edu	erg.sri.com	etak.com
extranet.oleane.net	fhwa.dot.gov	forthnet.gr
frisco.ch2m.com	Fsmodem.washington.edu	gen.cadvision.com
grta.org	gte17.rb1.bel	gtei.net
guidant.com	ix.netcom.com	korea.ac.kr
mcis.washington.edu	metapath.com	microsoft.com
mitretek.org	mtq.gouv.qc	netcom.com
netexpress.net	niatt.uidaho.edu	northgrum.com
ntu.edu.sg	odetics.com	olympia.wa.da.uu.net
open.org	ornl.gov	oscsystems.com
plstn1.sfba.home	r10.d.bel	ricochet.net
rsandh.com	s140.tnt2.nyw	saturn.bbn.com
scflw.guidant.com	sea.lightrealm.net	seanet.com
seattle-16-17rs.wa.dial-access	sfba.home.com	spsmodem.washington.edu
sttln1.wa.home	sys.Virginia.EDU	tamu.edu
tnt1.olympia.wa	tnt16.redmond.wa	tnt2.atl1.da
tnt4.sjc4.da	trac.washington.edu	trapsoft.com
tti.tamus.edu	umd.edu	unimelb.edu.au
uoregon.edu	usw4.rb1.bel	virginia.EDU
wam.umd.edu	wolfenet.com	wsdot.wa.gov

2. REAL-TIME DATA ACCESS

Groups external to WSDOT access data through the Self-Describing Data (SDD) interface. When the SDD software library is downloaded, we request that the user voluntarily provide an affiliation. The unique responses received during 2002 include those shown in Table 2.

Table 2: Voluntary affiliation identification

"Meyer, Mohaddes Associatiates" @home Airsys ATM Bell Business Systems Enginee Cheil Eng. Co. Cybermetrie EPP Gannett Fleming Inc Infomove Integrated Data Communication Karkalis Kong Market Machines Corp Mobility Technologies N/A Neurosoft Openet Telecom PT. Blom Nusantara RIA Self TANN Telemart Traffic.com UMM UW Univ of Texas @ San Anto VHB Wavetronix azure@hotmail city of Bellevue h infospace n/a (interested bystander) satya inc somani engineering ind tongji unemployed	"Software Center, Motorol" ASL Design Anderson & Associates BlackBox CF Patton Middle School City of Bellevue DCM Technologies Esgem Limited Günther Pichler G.m.b.H. Infomove.com Iteris Inc. King County MELT Microsoft MobilityWerks NA NiX P.S.U. Personal RMCS Shell TRAFTOOLS Telia TrafficStation UNO UW CSE University of California ViAir Westel International Ltd bluemartini computran hokuto ele insoft navigation technologies sergioolivas.com teleatlas tpso university of washington	Intec AT&T Atlas Software Tech Inc Blank Inc. Cheil Eng. Combix Corporation Dynamic FSAG Home Ingeniux Juxtapoz Design Kivera Mark Atwood MillerCentral Morgan State University NT None PB Farradyne Quantex Satyam Smartworks Ltd Tegic Communications Trac U.P.B. USC UW Computer Science University of Washington Virtuoso ZDiK cairo univercity diasoft iii mis none shenkar college thabone unaffiliated viathan corp.
---	---	--

Automatic Vehicle Location (AVL) using SDD provided data to 9,921 connections from 144 client addresses.

In 2001 alone, the transportation management system (TMS) data made available through the SDD framework were requested from 81 client addresses representing external requestors through 427,362 connections. Groups that have developed applications that use these data continuously include Traffic.tann.net, Traffic.iteris.com, Infomove.com, Wavetronix.com, Research.att.com, Trafficstation.com, Odetics.com, Navtech.com, and Viair.com.

3. EXTERNAL SUPPORT OF DATA

Because external data requests are supported by the ITS backbone, WSDOT engineers do not need to service these external customers. The backbone has serviced thousands of requests for data from hundreds of sites (see the statistics for AVL and TMS as well as TDAD data above). When averaged out, this represents a new client every 1.5 days. In particular, Traffic.com and Wavetronics have interacted quite a bit with the Backbone staff.

4. PROVISION OF A STANDARD INTERFACE

The Backbone provides a level playing field for external data users so that WSDOT provides comprehensive data sets equally to any external concerns, public or private.

5. SUPPORT OF RESEARCH

TDAD is used extensively by both external and WSDOT addresses. A variety of students and faculty at the UW who have received WSDOT funding have used the Backbone and TDAD for WSDOT projects. A currently funded project to use transit vehicles as probes will make speed data from freeways and arterials available on the backbone for use in traveler information and traffic management. A prototype map of real speed data is shown in Figure 6. This new, virtual sensor will provide speeds throughout King County without installing additional loops and is an example of the Backbone obtaining data from an external agency, performing data fusion and estimation, and producing virtual sensors for internal use by WSDOT

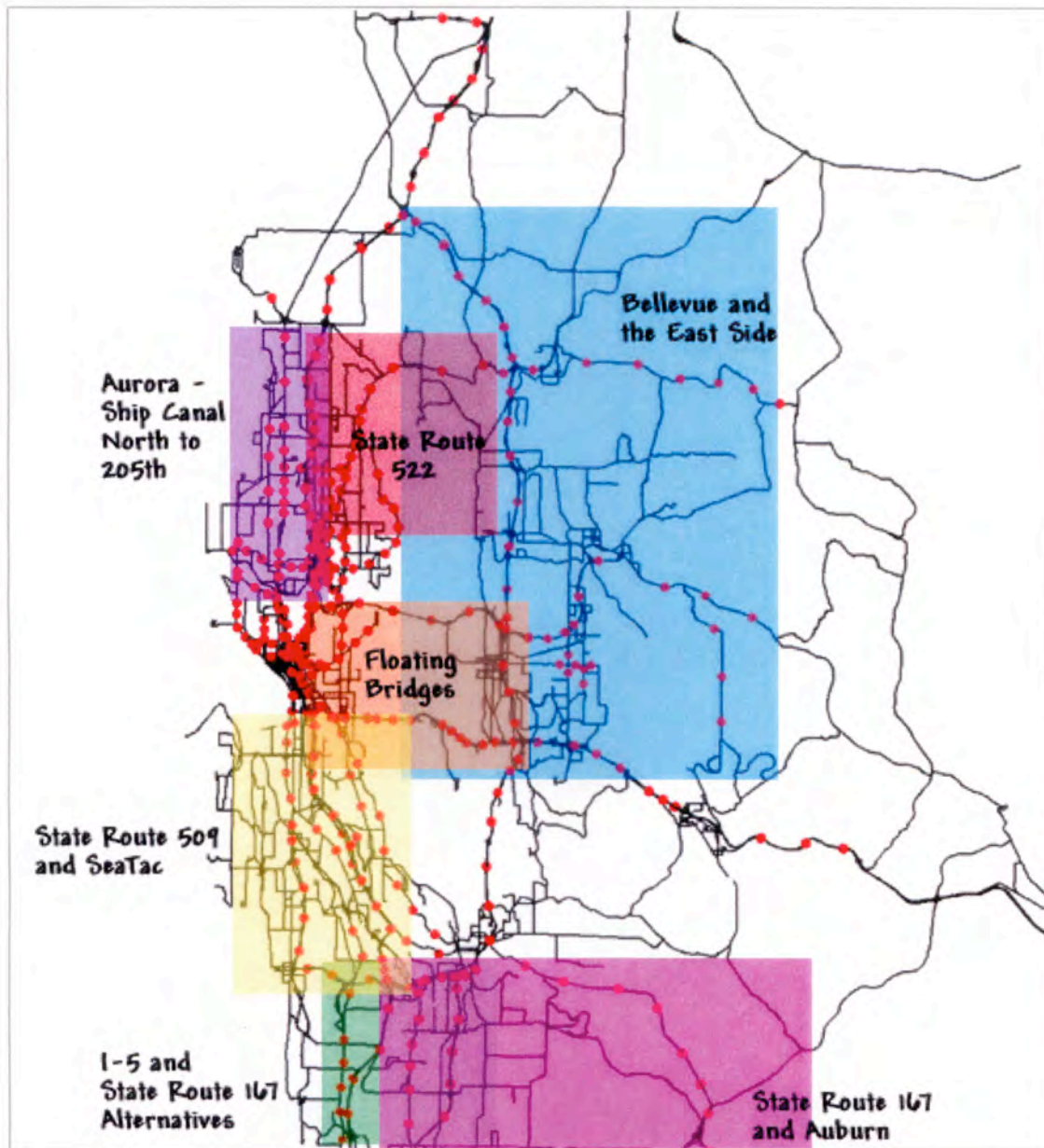


Figure 6: Prototype map of real speed data.

6. INCLUSION OF NEW DATA SOURCES INTO EXISTING TMS SYSTEM

As part of the Backbone effort, we have created methodologies and software to take SDD stream contents and include them in the Real Time Database used on the TSMC central traffic management computer systems. This will make several additional sources of data available through the established traffic management software. First, probe data from the Transit Vehicles as Probes research effort will be included for locations selected by TSMC personnel. Second, the data from the traffic systems and along SR 522 will be

inserted into the existing TMS. The framework created to include these new data sources is designed to be sufficiently flexible to allow for other, future sources. The Bellevue traffic management office plans on providing data to the TMS by using the interfaces developed for the ITS backbone.

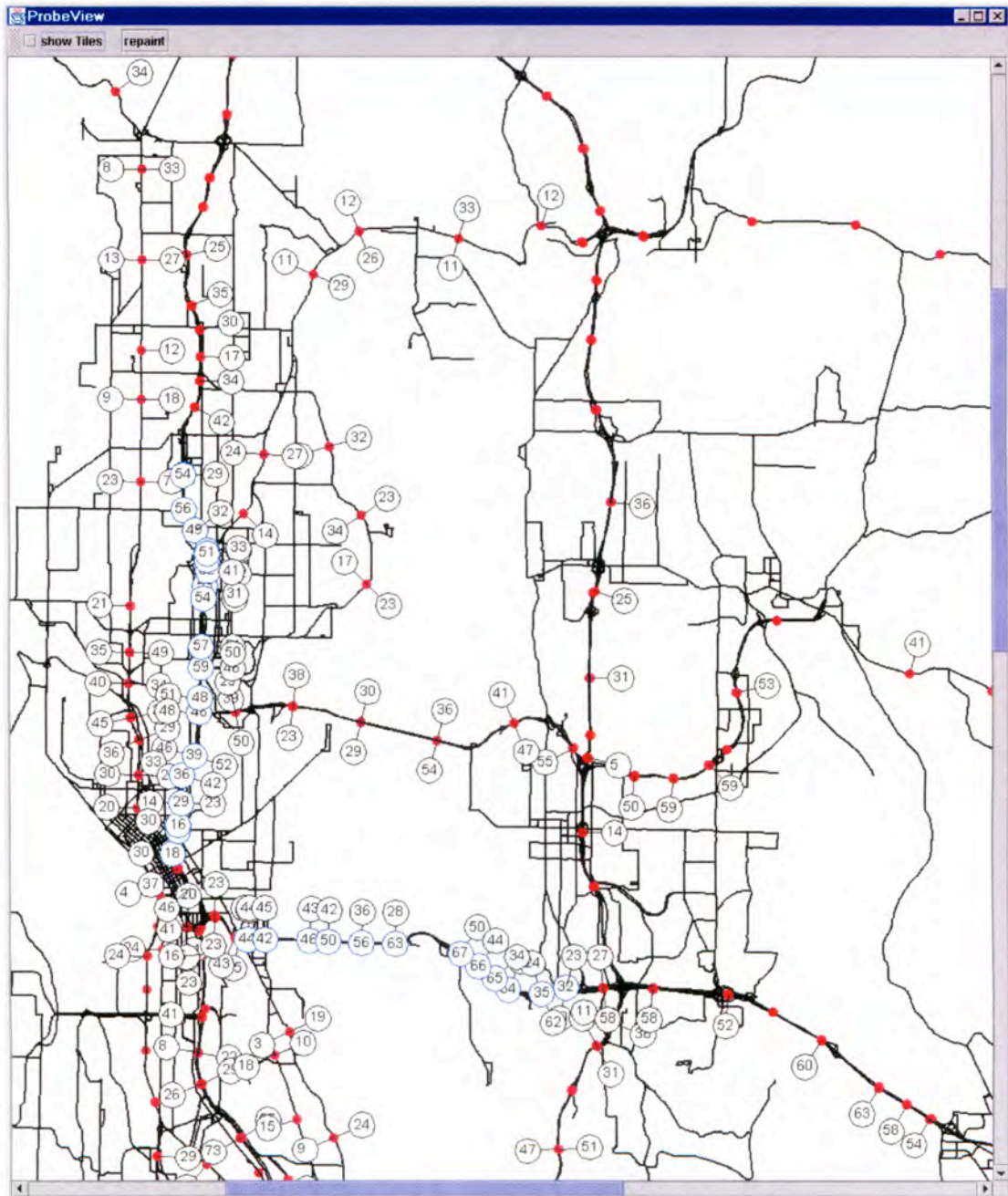


Figure 7: Virtual speed sensors on the ITS Backbone.

7. END USERS OF DEVELOPED PRODUCTS

1. *Travelers*: Presently in the thousands; potentially tens of thousands.
2. *Transportation-related state organizations using ITS services*: potentially dozens.
3. *Developers of ATIS products, both public and private sector partners*: potentially hundreds.

8. WORK ELEMENTS

1. Maintain hardware and software for existing backbone infrastructure. This addresses the maintenance of the backbone infrastructure resulting from the SmartTrek project.
2. Expand the existing backbone software to meet the needs for NTCIP center-to-center communication.
3. Expand Backbone data services to include probe vehicle information and video speed sensors.
4. Provide a standard interface to allow the existing TMS system at TSMC to include new data sources
5. Provide documentation, example source code, and consulting to allow ISPs access to any of the data flows available on the ITS backbone.
6. Respond to ISP requests for additional services.
7. Interact with evaluator to collect evaluation data.
8. Upgrade communications and computing hardware as necessary. Software security is an ongoing effort for any computers directly connected to the Internet.