Interim Research Report
Agreement T2695, Task 07
ITS Backbone Infrastructure

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by

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In this brief report, we provide a description of the activities in each of the areas to which the Backbone contributes, and we provide supporting statistics for each of these contributions. The form of these statistics varies by application area: (1) potential viewers, in the case of TrafficTV, (2) page views, in the case of MyBus, (3) data stream use, in the case of Busview, and (4) number of downloads, in the case of the SDD Toolkit.

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Table of Contents

List of Figures and Tables

A Brief Report on Activities for the ITS Backbone in 2002

The Intelligent Transportation Systems (ITS) Backbone performs several important tasks for ongoing efforts at the Washington State Department of Transportation (WSDOT) and the 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 to Backbone staff

(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 nation wide

(6) provides a standard interface to include new data sources into the existing TMS System.

In this brief report, we provide a description of the activities in each of the areas to which the Backbone contributes, and we provide supporting statistics for each of these contributions. The form of these statistics varies by application area: (1) potential viewers, in the case of TrafficTV, (2) page views, in the case of MyBus, (3) data stream use, in the case of Busview, and (4) number of downloads, in the case of the SDD Toolkit.

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 include both traffic and transit components.

1.1 TRAFFIC APPLICATIONS

Traffic Channel: This automated program, begun June 1, 1998, is available on UWTV2 and is carried on AT&T broadband cable channel 76 from 5:00 – 8:00 a.m., and 2:30-7:00 p.m. It is available in the populous regions of King, Pierce, and Snohomish counties, as shown in the coverage map, and has potential viewers in 430,900 households.

Figure 1: Current TrafficTV viewer coverage area

It is also available on channel 9400 of the Dish 500 Network, although regional subscriber impact of this outlet is unknown. The on-air broadcasts from UWTV2 are also streamed on the Internet and available from **http://www.washington.edu/uw2tv/.** Staff members supported by the ITS Backbone project at the UW respond to requests for equipment repairs, camera changes, and software updates by both UWTV and WSDOT. A new version of TrafficTV, improved on the basis of feedback from SmartTrek evaluations and input from WSDOT and UWTV, will be available second Quarter of 2003. In addition to the ITS Backbone, the TrafficTV application uses real-time camera feeds, available by way of WSDOT and UWTV fiber connections, to provide a realistic portrayal of traffic conditions at selected locations. Details on the implementation of this application can be found at **http://www.its.washington.edu/trafchan/.**

TDAD: Traffic Data Acquisition and Distribution is a data-mine that contains 20-second average inductance loop data for all of the WSDOT sensors. Since it began in 1998 it has been accessed 3,948 times by 338 unique clients; the domains that have accessed TDAD are shown in Table 1. In 2002, TDAD was used 754 times by 69 unique clients. TDAD depends upon the Backbone project both to obtain the data and for operational support provided by the Backbone staff.

Trafnet: This early traveler information application is still available on the internet and provides speed and travel time information for a user-selectable set of trips. It remains the only application that provides user-selected destination travel times and average speed.

Table 1: Domains that have downloaded TDAD data

CCIT.Arizona.EDU	CE.Arizona.EDU	EECS.Berkeley.EDU	RTNA.DaimlerChrysler.COM
accessone.com	achs.Virginia.EDU	adobe.com	amre.com
ap.t.u-tokyo.ac.jp	metconnect.net	benchmark.com	biz.dsl.gtei.net
boeing.com	bootp.Virginia.EDU	bsquare.com	capnet.state.tx.us
ce.Arizona.EDU	ce.ndsu.NoDak.edu	ce.utexas.edu	ce.washington.edu
ch2m.com	chi.navtech.com	ci.colospgs.co.us	ci.redmond.wa.us
cisco.com	citg.tudelft.nl	city.oshawa.on.ca	client.attbi.com
client.dsl.net	clientes.euskaltel.es	co.clark.wa.us	consultec-llc.com
cortland.com	coventry.ac.uk	cpsrta.org	cybercable.tm.fr
deainc.com	dhcp.pdx.edu	dhcp.washington.edu	dhcp2.washington.edu
dialup.maths.uwa.edu.au	dot.state.oh.us	dot.state.wi.us	dsl.gtei.net
dsl.mindspring.com	dsl.snfc21.pacbell.net	dsl.speakeasy.net	ecn.purdue.edu
ecom.unimelb.edu.au	ed.ornl.gov	ee.washington.edu	eecs.umich.edu
eng.uci.edu	engineering.Virginia.edu	erg.sri.com	etak.com
extranet.oleane.net	fedwy1.wa.home.com	fhwa.dot.gov	forthnet.gr
smodem.washington.edu	fwhq2nat.dot.ca.gov	gen.cadvision.com	gfnet.com
grta.org	gte17.rb1.bel.nwlink.com	gtecablemodem.com	guidant.com
hitl.washington.edu	hntb.com	hr.hr.cox.net	hrl.com
inro.tno.nl	interactivenw.com	its.washington.edu	ix.netcom.com
korea.ac.kr	lvs.dupont.com	maths.uwa.edu.au	mcis.washington.edu
metapath.com	microsoft.com	mtq.gouv.qc.ca	net.ca.gov
netexpress.net	niatt.uidaho.edu	nics.gov.uk	njit.edu
norf.east.verizon.net	northgrum.com	ntu.edu.sg	nwnexus.net
nycap.rr.com	odetics.com	open.org	oz.net
plstn1.sfba.home.com	pnl.gov	proxy.aol.com	r10.d.bel.nwlink.com
res.gatech.edu	ricochet.net	rsandh.com	rcn.com
saturn.bbn.com	sdsl.cais.net	sea.lightrealm.net	sea1.cablespeed.com
seanet.com	seatimes.com	att.net	slkc.uswest.net
Berkeley.EDU	sttl.uswest.net	sttln1.wa.home.com	sttls1.wa.home.com
sys.Virginia.EDU	tamu.edu	tc.ph.cox.net	tci.com
tcsn.uswest.net	tnt1.olympia.wa.da.uu.net	tnt1.pullman.wa.da.uu.net	.wa.da.uu.net
.redmond.wa.da.uu.net	tnt2.atl1.da.uu.net	tnt4.sjc4.da.uu.net	trac.washington.edu
translink.bc.ca	trapsoft.com	treas.gov	tti.tamus.edu
uoregon.edu	bel.nwlink.com	usw4.rb1.bel.nwlink.com	wam.umd.edu
wavetronix.fiber.net	Wilmington5.de.pub-ip.psi.net	wolfenet.com	wsdot.wa.gov
z208036246.chi-il.dsl.cnc.net	Zgi.com		

1.2 TRANSIT APPLICATIONS:

MyBus: MyBus was accessed 146,074,292 times in 2002, with over 15 million in March 2002. Usage was distributed over the course of the year as shown in Figure 2.

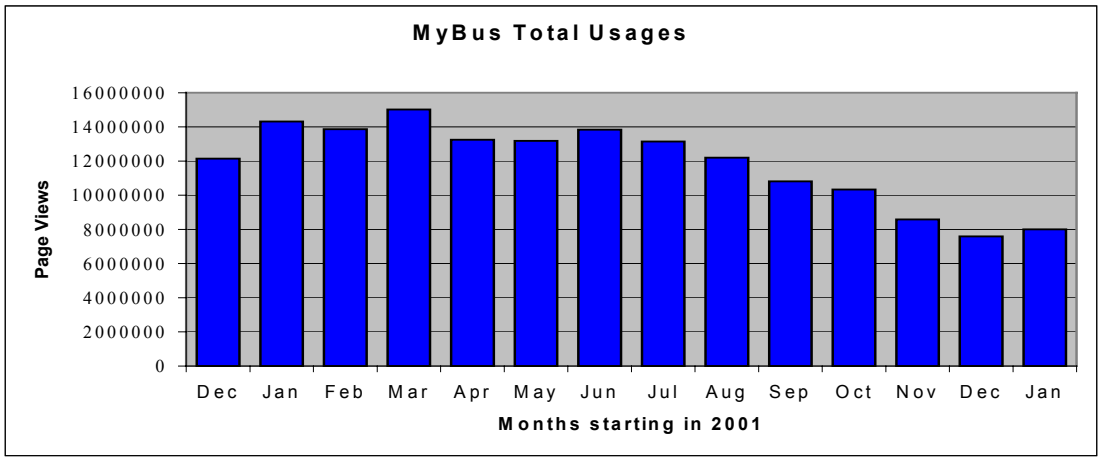

Figure 2: MyBus total page views, December 2001 through January 2003

Access was from over 31,488 distinct client addresses, including the largest user, Microsoft. The effect of removing the Microsoft usage numbers from the page views is dramatic, and the result is shown in Figure 3.

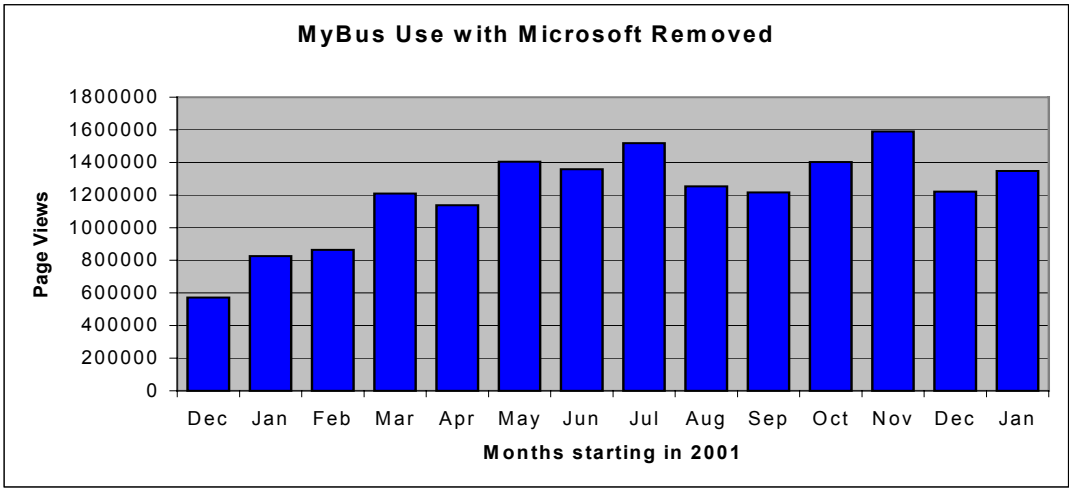

Figure 3: MyBus usage with Microsoft numbers removed

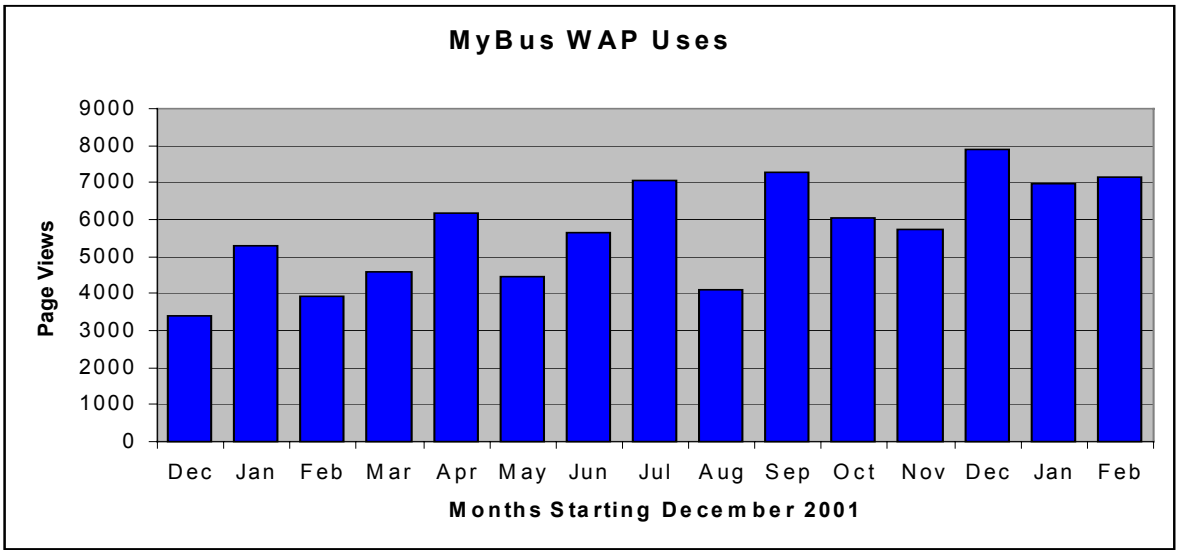

Figure 4: MyBus WAP phone site usage beginning December 2001

In addition to the web site, there is the MyBus Wireless Access Protocol (WAP) phone site, with an average usage of about 5,700 per month, which is increasing in number, as shown in Figure 4.

The newest deployment is MyBus for the Personal Digital Assistant (PDA), which has seen relatively small usage to date, as shown in Figure 5.

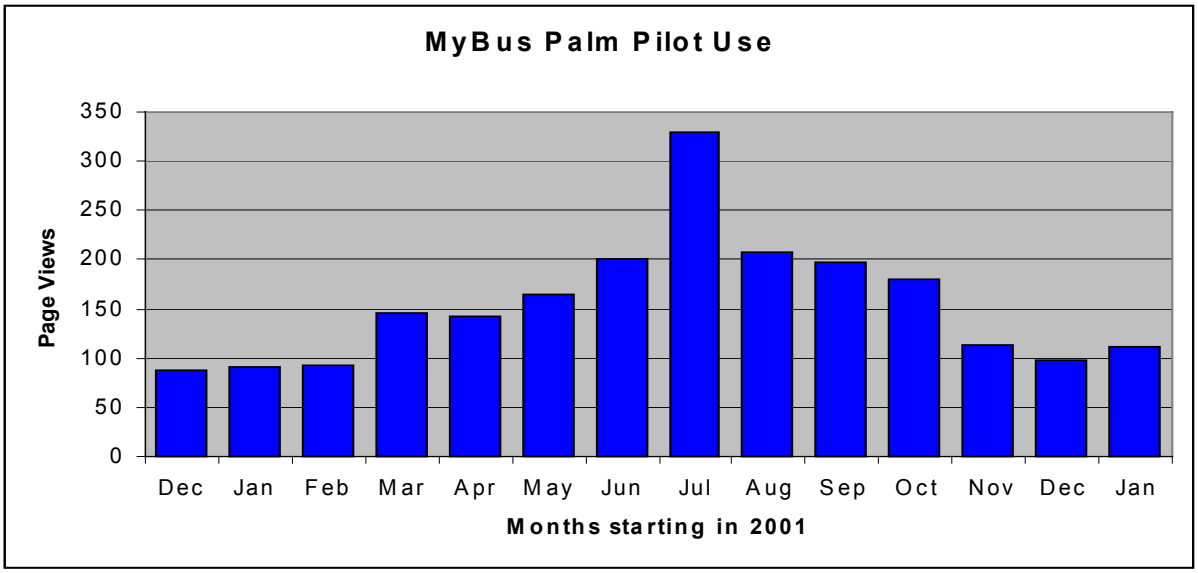

Figure 5: MyBus Palm usage beginning December 2001

Busview: A user of Busview opens the launch page, downloads the Busview applet, and then makes a connection to Busview.org to get the data stream. Figure 6 shows the number of times the launch page was viewed over the course of 2002. Figure 7 shows the number of times that the Busview applet connected from a remote host to Busview.org. There were 400,452 connections to the data stream distributed throughout the year, as shown in Figure 7. We speculate that the large peak in July is not from individual use. There was stable usage of around 10,000 per month but with spikes as high as 16,000 in November.

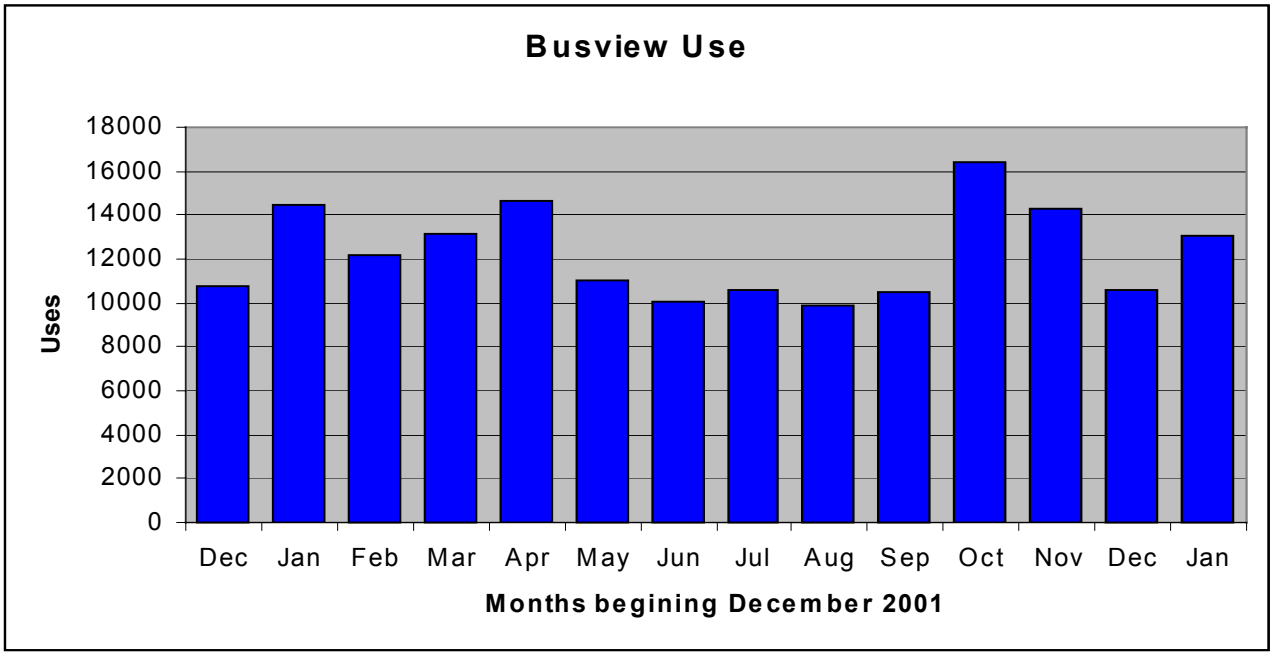

Figure 6: Busview launch page views

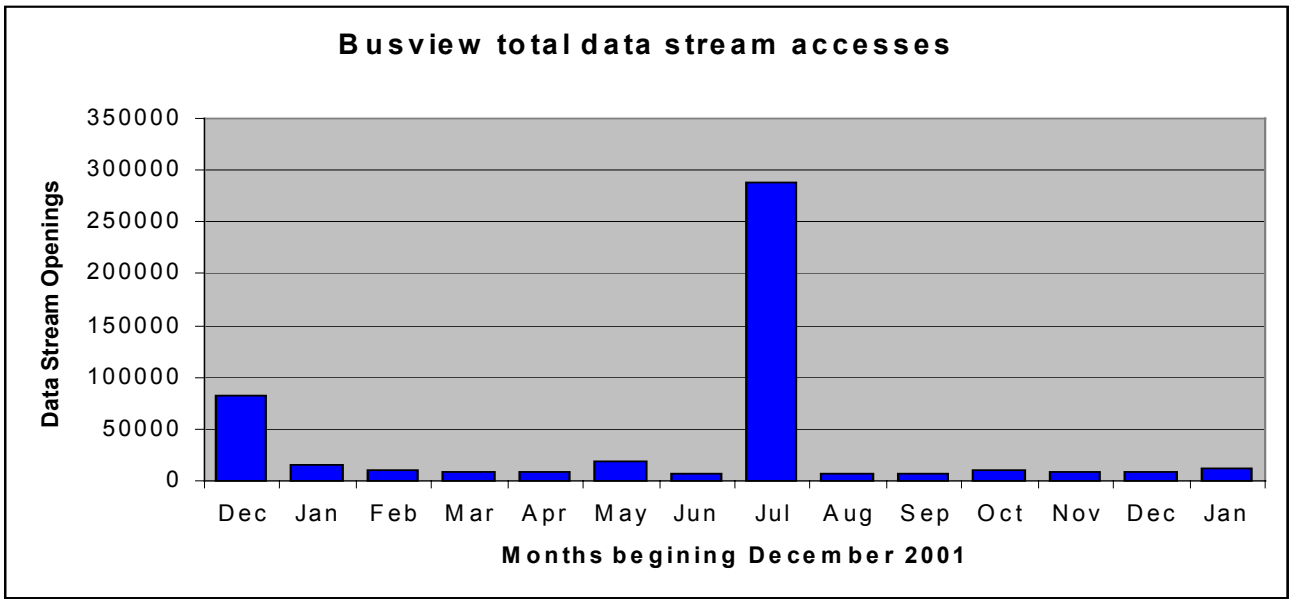

Figure 7: Busview data stream accesses

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. The new Bellevue Transit Center features several displays. In addition, signs at individual bus stops are under construction.

Multi-Modal Transit Support: This ongoing project combines maps, schedules, and Automatic Vehicle Location (AVL) information from four transit agencies. It is a real-time demonstration of multi-modal, multi-agency traveler information system conducted over a three-county region. It demonstrates the viability of traveler information and traffic management systems that span four agencies (Sound Transit, Pierce Transit, Community Transit, and Metro King County Transit) and two vehicle types (transit buses and Sounder Train service), as well as two types of automatic vehicle location systems (Global Positioning System (GPS) and signpost-assisted dead reckoning). The Busview and MyBus programs have been enhanced to now include information from all the agencies listed. The multi-modal versions depends on the ITS Backbone for real-time vehicle information.

2. REAL-TIME DATA ACCESS

Groups external to WSDOT access ITS Backbone 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 SDD toolkit was downloaded by both public and private sector entities; a cumulative subset of the private sector entities whose IP address resolved to a domain name is shown in Table 2, and a subset of the public sector in Table 3. It is noteworthy that these are only the voluntary reports; the total number of toolkit downloads was 297. The public and private set for March 2002 – February 2003 is shown in Table 4. The total number of downloads was 88.

Table 2: Private sector downloads

Accenture	Airsys ATM	AllWays, Inc.	Anderson & Associates
ASL Design	AT&T	Atlas Software Tech Inc.	Batelle
Blue Martini Software	Business Systems Engineering, Inc.	Carter & Burgess Consultants	CET Technologies
Cheil Engineering Co.	Combix Corp.	Combix Corp.	Computran
Cybermetrie	DCM Technologies	Decisioncraft	Depository Trust & Clearing Corporation (DTCC)
Diasoft	ESGEM Ltd.	Gannett Fleming Inc.	Getronics
Gray Hill Solutions, LLC	Hokuto Electronics	Infomove	InfoSpace
Ingeniux	Insoft	Integrated Data Communications	Iteris, Inc.
Kivera	Market Machines Corp	Meyer, Mohaddes Associates	Microsoft
Mitretek Systems	Mobility Technologies, Inc. (Traffic.com)	Motorola (Software Center, China)	Navigation Technologies (Navtech)
Neurosoft	Openet Telecom	PB Farradyne	Pharos, Inc.
Point B Telematics	PT. Blom Nusantara	Quantex	Satyam Infoway
Science Applications International Corp. (SAIC)	Shell	Smartworks Associates, Ltd.	Snapp Consulting
Somani Engineering Industries	Technology Service Corporation	Tegic Communications	Tele Atlas
Telemart	Telia	TrafficStation	Traftools
Transparent Solutions	Travel Advisory News Network (TANN)	United Signal Control	Vanasse Hangen Brustlin, Inc. (VHB)
ViAir	Viathan	Vindigo	Wavetronix
Westel International Ltd.	BlackBox		

Table 3: Public sector downloads

Beihang University (BUAA)	Cairo University
Centre for Research in Computation and Applications (CERCA), University of Montreal	Chengdu University of Information Technology
City of Bellevue	ITS of Southeast University (China)
Metro King County	Ministry of Infrastructure, Housing, and Transportation (MELT), France
Morgan State University	Pacific Northwest National Laboratory
Shenkar College (Israel)	Universitatea Politehnica Bucharest (UPB), Romania
University of California	University of Montreal
University of Texas	University of Washington
Washington State Transportation Center (TRAC), University of Washington	Yonsei University
ZDiK (Street and Transport Authority, Poland)	

Table 4: March 2002 – February 2003 downloads

Gray Hill Solutions, LLC	University of Montreal
Point B Telematics	University of Washington
Science Applications International Corp (SAIC)	Yonsei University
Combix Corp	Pacific Northwest National Laboratory
Vindigo	ITS of South East University(China)
Technology Service Corporation	Beihang University
Mitretek Systems	Pharos, Inc
CET Technologies	Snapp Consulting
United Signal Control	Getronics
Battelle	Carter & Burgess Consultants
Depository Trust & Clearing Corp (DTCC)	Decisioncraft
Accenture	Centre for Research in Computation & Applications (CERCA), University of Montreal

Once the external users download the toolkit, they then access the data streams. The AVL SDD stream provided data to 9,921 connections from 144 client addresses.

In 2002 alone, the transportation management systems (TMS) data made available through the SDD framework had 427,362 connections for data. These connections came from external requestz with 81 different addresses. Example groups that have developed

applications that use these data continuously include traffic.tann.net, traffic.iteris.com, informove.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 FOR RESEARCH

TDAD is used extensively by both external and WSDOT addresses. A variety of students and faculty at the UW who have WSDOT funding have used the Backbone and TDAD for WSDOT-funded projects. A presently 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 8. 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

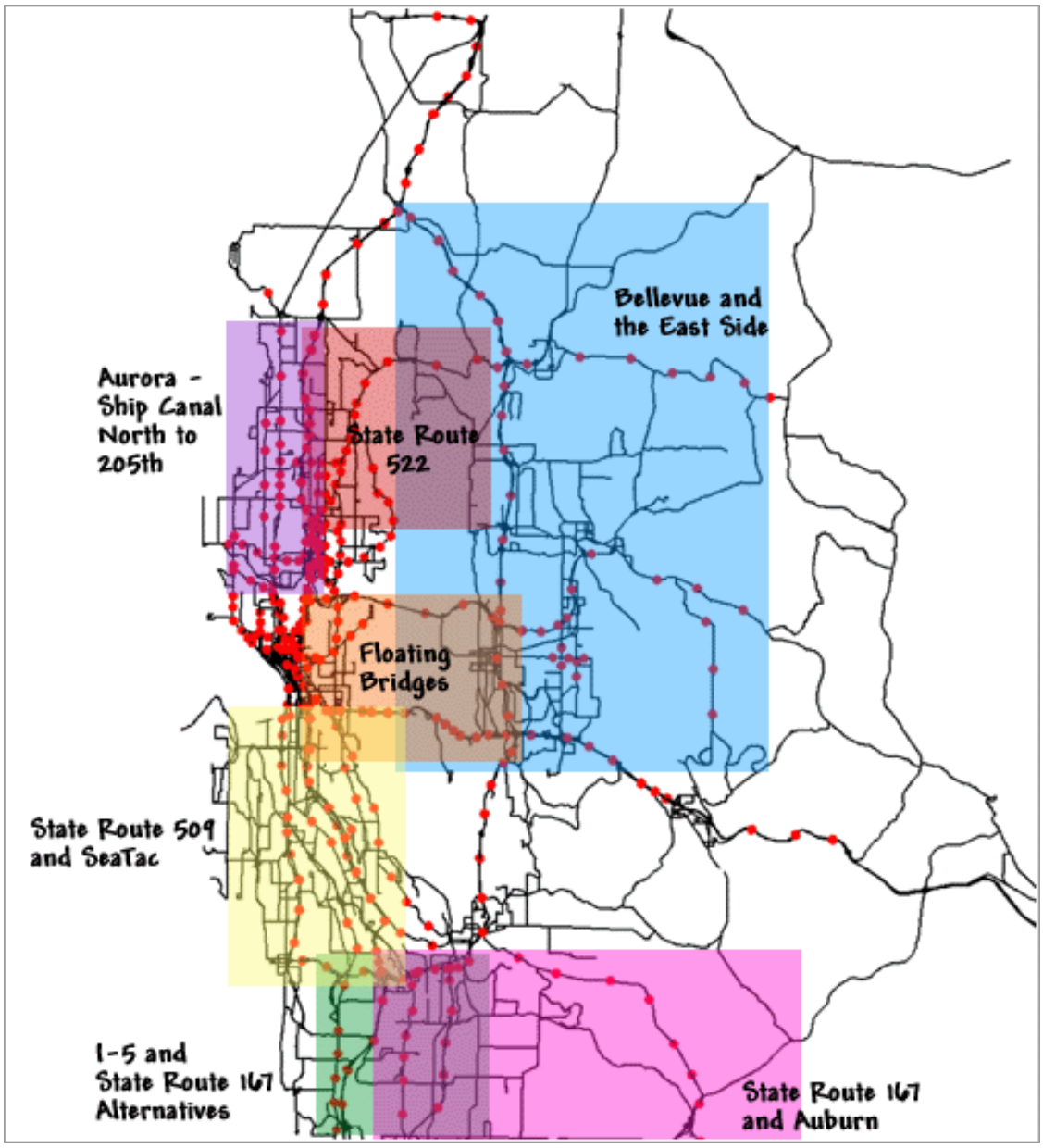

Figure 8: Prototype map of real speed data

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 Traffic Systems Management Center (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 has made speed data available for locations selected by TSMC personnel. In particular, speed data from SR 99, as seen in Figure 9, are available and can be included in the standard TMS operations framework. This provides traffic data where no sensing capabilities are currently available on SR 99 near Seattle. This is equally true on SR 509 in the SeaTac region. Backbone staff have implemented and demonstrated code to place the probe vehicle data into the existing TMS computer to make them accessible to the TMS operators through their established interface.

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 using interfaces developed for the ITS backbone. The Bellevue DOT is a constant consumer of data from the Backbone, as is the North Seattle Advanced Traffic Management System (NSATMS) within the Northwest Region's operations facility.

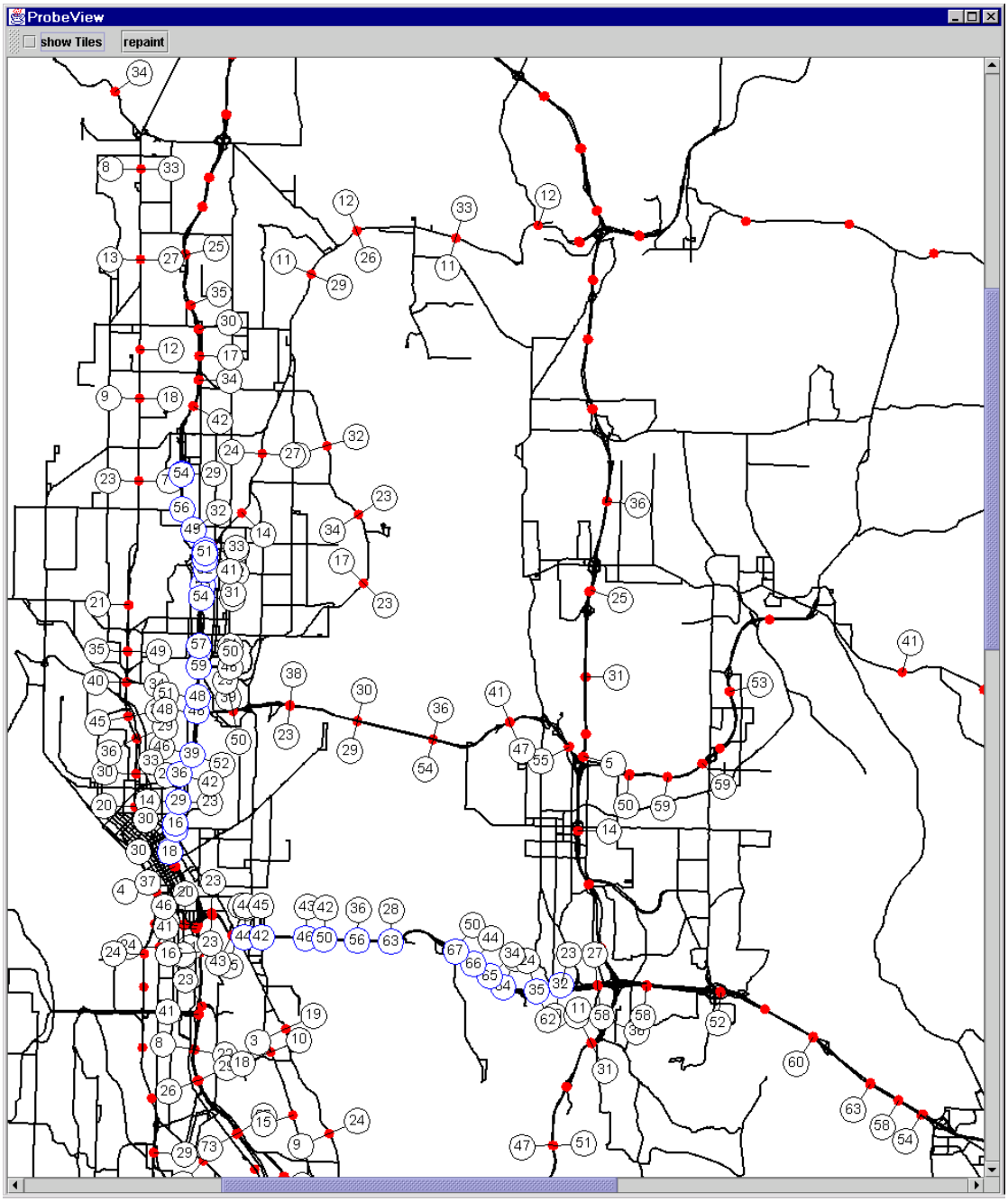

Figure 9: Virtual speed sensors on the ITS Backbone

7. END USERS OF DEVELOPED PRODUCTS

1. *Travelers:* 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 ACCOMPLISHED IN 2002

1. Maintained hardware and software for the existing backbone infrastructure. This addressed the maintenance of the backbone infrastructure resulting from the SmartTrek project.
2. Expanded the existing backbone software to meet the needs of National Transportation Communications for ITS Protocol (NTCIP) center-to-center communication.
3. Provided a standard interface to allow the existing TMS system at the TSMC to include new data sources
4. Provided documentation, example source code, and consulting to allow Internet Service Providers (ISP) access to any of the data flows available on the ITS backbone.
5. Responded to ISP requests for additional services.
6. Interacted with an evaluator to collect evaluation data.
7. Upgraded the communications and computing hardware as necessary. Software security is an ongoing effort for any computers directly connected to the Internet.

9. SUMMARY LIST OF ONGOING PROJECTS

The following ongoing projects are supported by the backbone:

(1) TrafficTV

(2) Probe vehicles

(3) TRAC sponsored research

(4) TDAD

(5) Lynnwood data integration

(6) Bellevue data integration

(7) Integration of external data sources into Traffic Management Systems (WOPPER)

(8) Multi-modal transportation and transit projects

(9) Public/private data access

(10) NSATMS