Research Report
Agreement T2695, Task 87
ITS Backbone

ITS Backbone

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16. ABSTRACT

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, (4) number of downloads, in the case of the Self Describing Data (SDD) Toolkit and, (5) use of the Web services.

The ITS Backbone has been financially supported by WSDOT to provide a level playing field to distribute detailed real-time and historical data to the public, private, and research sectors.

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A Brief Report on Activities for the ITS Backbone in 2005-6

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 the 2005-2006 Biennium 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, (4) number of downloads, in the case of the SDD Toolkit, and (5) the usage of the Web services for transit and traffic data.

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 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 to 8:00 a.m., and 2:30 to 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 the 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. 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/.**

Note: **(1) New versions of hardware and software have been created.**
(2) UWTV took TrafficTV off the air in July 2006 to negotiate additional payments from WSDOT.

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 9606 times; the domains that have accessed TDAD are shown in Table 1. In 2005/7, TDAD was used 2291 times by 217 unique clients. TDAD depends upon the Backbone project both to obtain 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

	ECE.CMU.EDU	Reshall.Berkeley.EDU
TAMU.EDU	bc.dl.cox.net	block.alestra.net.mx
bos.east.verizon.net	cae.wisc.edu	ce.ncsu.edu
ce.washington.edu	cee.pdx.edu	cee.wisc.edu
ci.bellevue.wa.us	columbus.res.rr.com	coral8.com
corp.hp.com	cs.washington.edu	cust-adsl.tiscali.it
decisiv.net	dhcp.missouri.edu	dhcp4.washington.edu
digitalaccess.net	dkssea.com	dot.state.wi.us
dsl.scrm01.sbcglobal.net	dsl.snfc21.pacbell.net	dyn.grandenetworks.net
dynamic81215211161.ttnet.net.tr	ece.ohio-state.edu	ee.washington.edu
engineering.Virginia.EDU	engr.wisc.edu	engr1.ohio-state.edu
eos.ncsu.edu	flagstaff.az.npgco.com	ga.at.cox.net
herntx.dsl-w.verizon.net	hntb.com	hsd1.mn.comcast.net
hsd1.or.comcast.net	hsd1.wa.comcast.net	ibdim.edu.pl
ip.tsinghua.edu.cn	irss.unc.edu	its.washington.edu
lightstreamdata.com	lut.ac.uk	microsoft.com
na.baesystems.com	nomads.utk.edu	ornl.gov
parametrix.com	ph.ph.cox.net	pool82105.interbusiness.it
resnet.wisc.edu	sdsu.edu	sea1.dsl.speakeasy.net
seattleu.edu	spmodem.washington.edu	starbucks.com
static85100120140.ttnet.net.tr	sttlwa.dsl-w.verizon.net	tamu.edu
tc.gc.ca	tukw.qwest.net	ucsd.edu
ucwphilly.res.rr.com	uwnet.wisc.edu	vtti.vt.edu
xlate.ufl.edu		

1.2 Transit Applications

MyBus: MyBus was accessed 88,800,655 times in 2005/7 (see Figure 2).

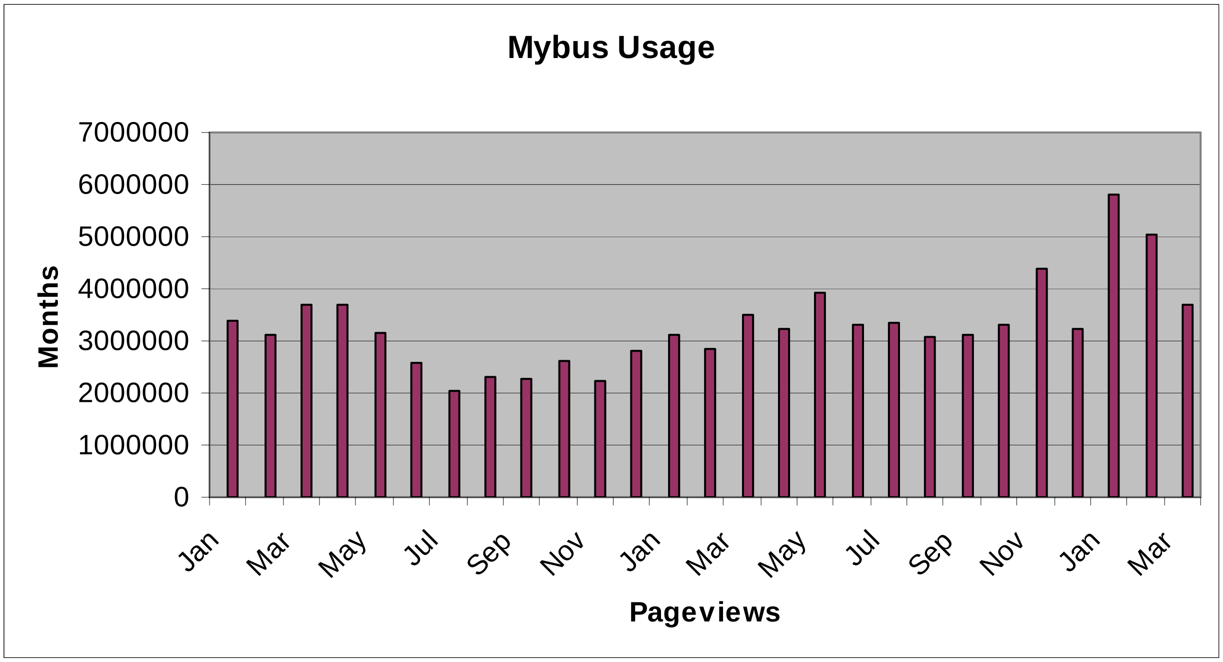

Figure 2: MyBus total page views.

In addition to the Web site, there is the MyBus Wireless Access Protocol (WAP) phone site, with an average usage of about 24,100 calls per month. This number is increasing, as shown in Figure 3.

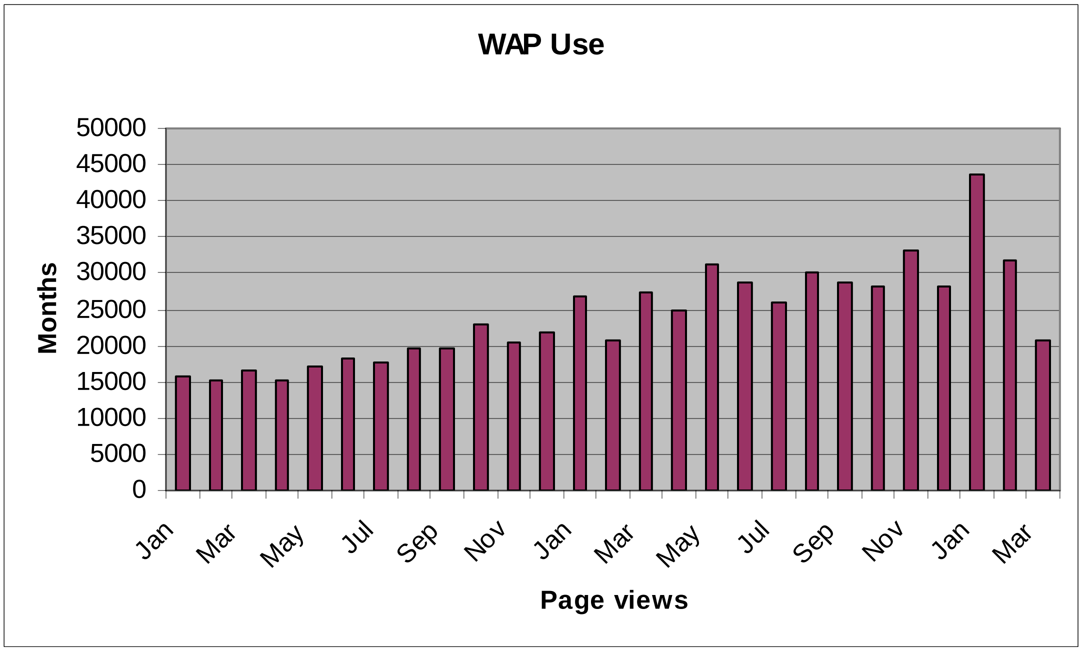

Figure 3: MyBus WAP phone site usage 2005/7

Also available is a short message service (SMS) version of MyBus, and the usage is shown in Figure 4.

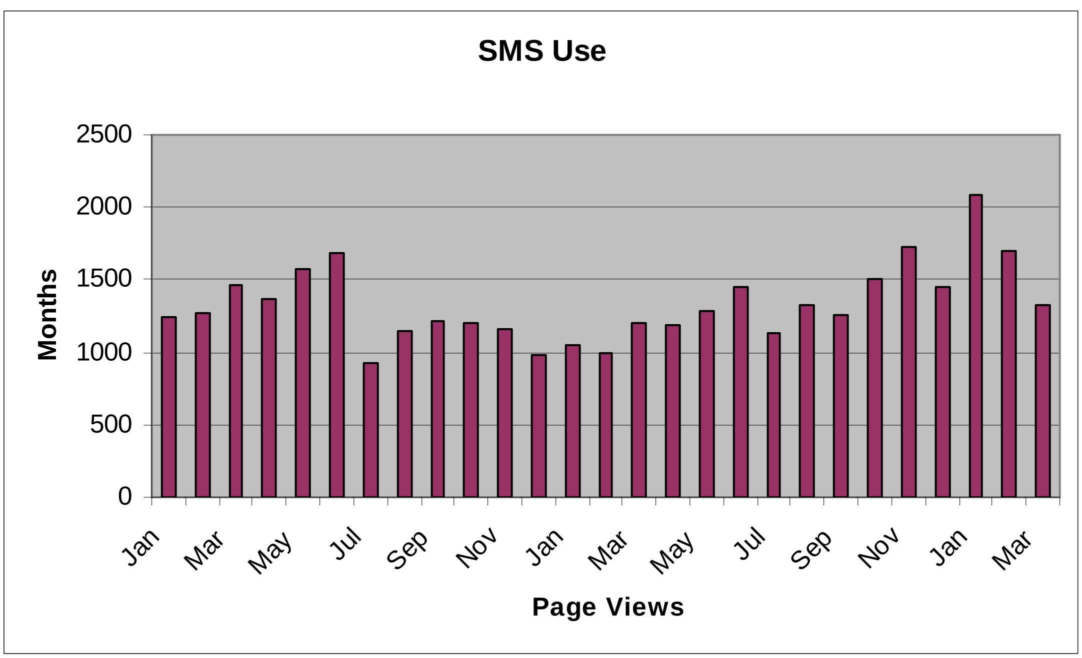

Figure 4 SMS usage.

The newest deployment is MyBus for the personal digital assistant (PDA), which had seen relatively small usage until February 2007 and then jumped to tens of thousands, as shown in Figure 5.

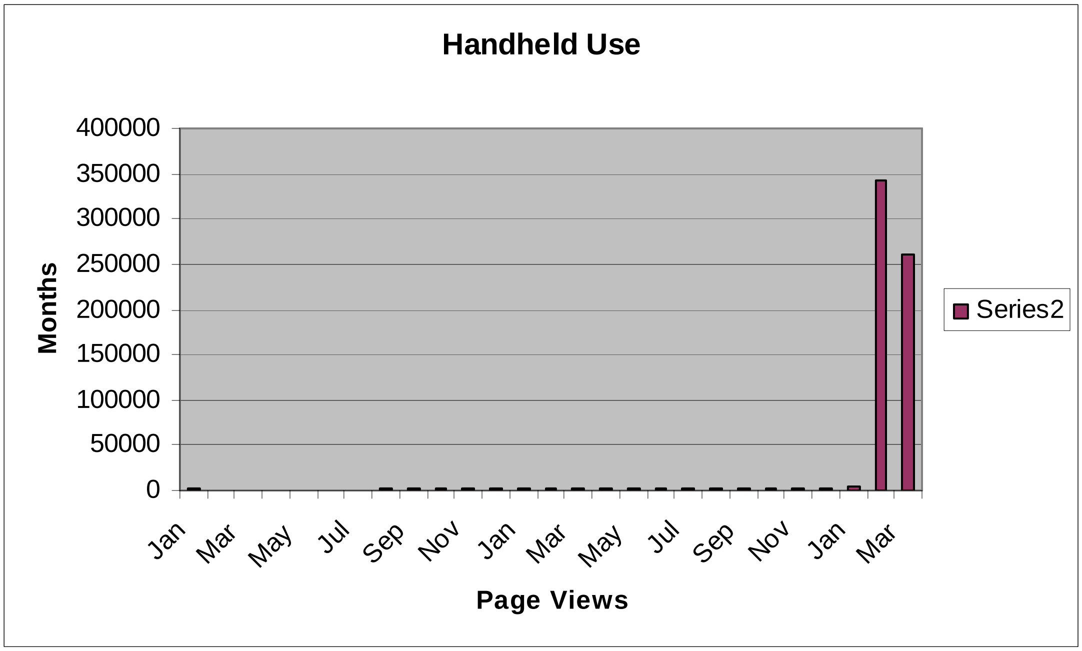

Figure 5 Hand Held PDA usage.

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 that the Busview applet connected from a remote host to Busview.org. There were 4,768,654 connections to the data stream distributed throughout the year. Usage was stable at around 176,000 connections per month.

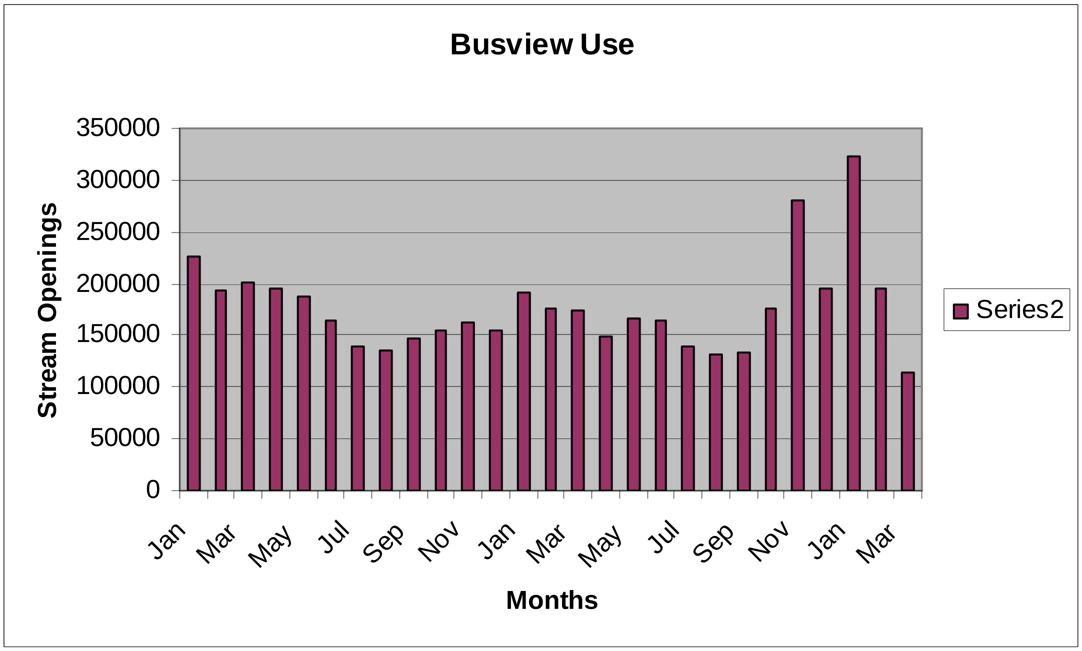

Figure 6: Busview data stream accesses

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 a 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 depend 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.

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 W	University of Washington

Once the external users download the toolkit, they then access the data streams. The AVL SDD stream provided data to 9,921 connections from 101 client addresses.

In 2005/7, 1,250,051 connections from 134 unique hosts were made to access the transportation management systems (TMS) data made available through the SDD framework. These connections came from external requests. 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 (see Table 4).

Table 4: SDD Host List

115.227.221.broad.wx.js.dynamic.163data.com.cn.	115.82.176.res-cmts.eph.ptd.net.
115.82.198.res-cmts.eph.ptd.net.	115.86.99.res-cmts.eph.ptd.net.
140.74.65.heraklesdata.net.	152.193.100.res-cmts.eph.ptd.net.
152.193.128.res-cmts.eph.ptd.net.	152.198.94.res-cmts.eph.ptd.net.
152.207.65.res-cmts.eph.ptd.net.	152.208.133.res-cmts.eph.ptd.net.
152.209.116.res-cmts.eph.ptd.net.	152.210.146.res-cmts.eph.ptd.net.
152.213.219.res-cmts.eph.ptd.net.	152.214.33.res-cmts.eph.ptd.net.
152.215.187.res-cmts.eph.ptd.net.	152.217.226.res-cmts.eph.ptd.net.
161.28.167.cust.pharo.sprintlink.net.	164.24.25.static.sna.hosting.com.
168.60.forest.net.	237.1.130.ptr.us.xo.net.
237.1.140.ptr.us.xo.net.	adsl.anteldata.net.uy.
amazon.com.	andrew.cmu.edu.
cac.washington.edu.	covestic.com.
cs.washington.edu.	cyphertext.net.
dhcp4.washington.edu.	dialup.adsl.anteldata.net.uy.
dsl.mindspring.com.	dsl.pltn13.pacbell.net.
dsl.wotnoh.ameritech.net.	ee.washington.edu.
hsd1.mn.comcast.net.	hsd1.pa.comcast.net.
hsd1.wa.comcast.net.	sfbaytraffic.info.
inrix.com.	its.washington.edu.
lmdaca.adelphia.net.	mct.phantomworks.org.
microsoft.com.	nocharge.com.
odetics.com.	olympus.net.
pharosgps.com.	plantsix.com.
sea1.dsl.speakeasy.net.	seattleu.edu.
sfo2.bloodmagic.us.	static.gdt.cust.seg.NET.
static.twtelecom.net.	sttlwa.dsl-w.verizon.net.
sttnwaho.dynamic.covad.net.	subnet128.229.218.216.in-addr.arpa.
tmodns.net.	trac.washington.edu.
traffic.com.	z214-94-67.customer.algx.net.

In addition, a **Web services portal** was created for both the transit and traffic data. Information on using these services can be found at:

http://www.its.washington.edu/its_ws.html

The **Mybus Service** was used 2,848,564 times, and the **TMS Service** was used 243,413 times in the 2005/7 timeframe.

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 the 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 7. This new, virtual sensor will provide speeds throughout King County without installation of 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

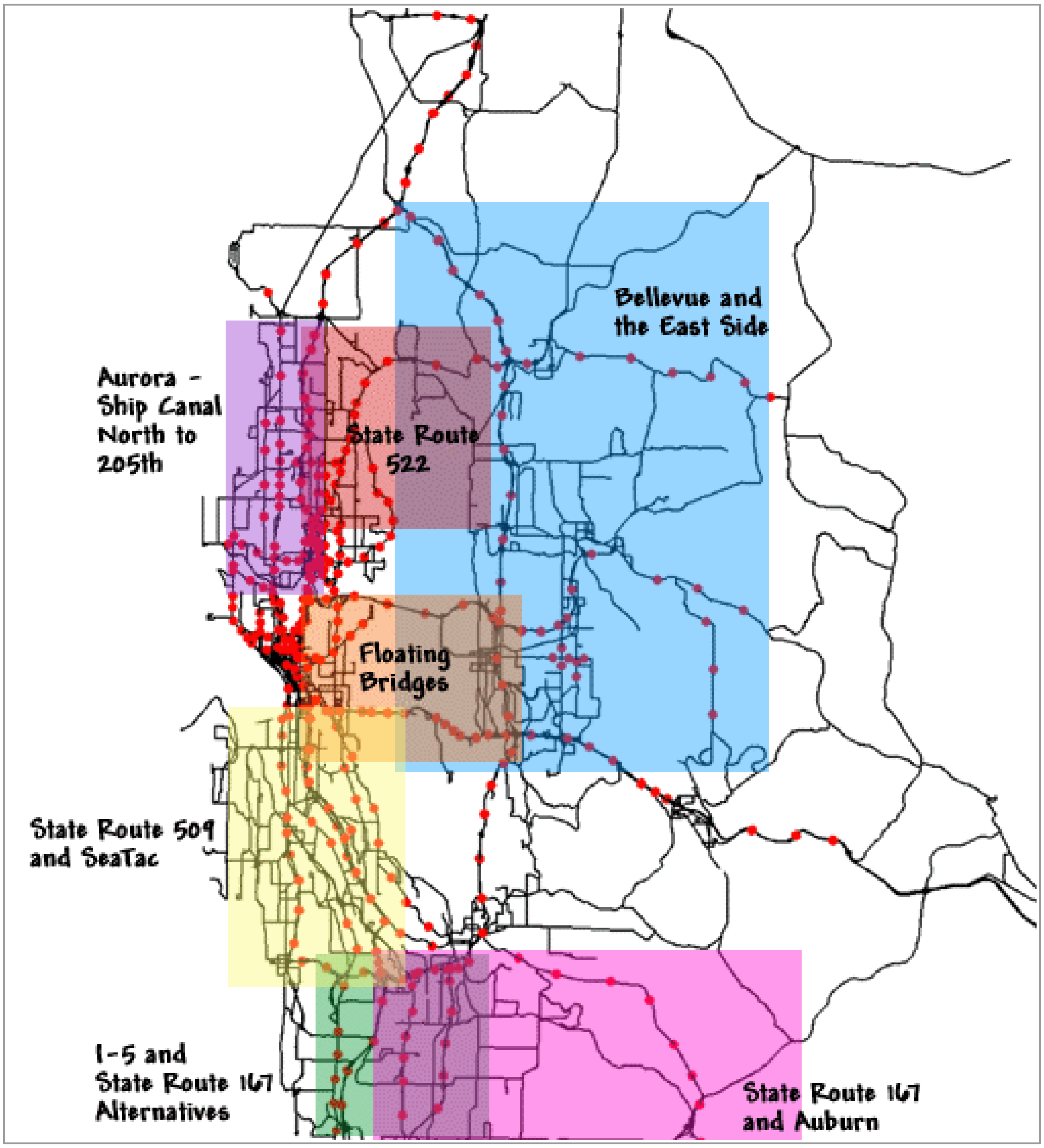

Figure 7: Prototype map of real speed data

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 by 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 hves made speed data available for locations selected by TSMC personnel. In particular, speed data from SR 99, as seen in Figure 8, 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 by 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.

Several applications are made available from its.washington.edu. The Storeview application (http://www.its.washington.edu/storeview/storeview.jnlp) was used 6618 times by 72 unique hosts (started 2/11/05). The ProbeView application, (http://www.its.washington.edu/probeview/probeview.jnlp) was used 2001 times by 171 unique hosts (started 8/18/04).

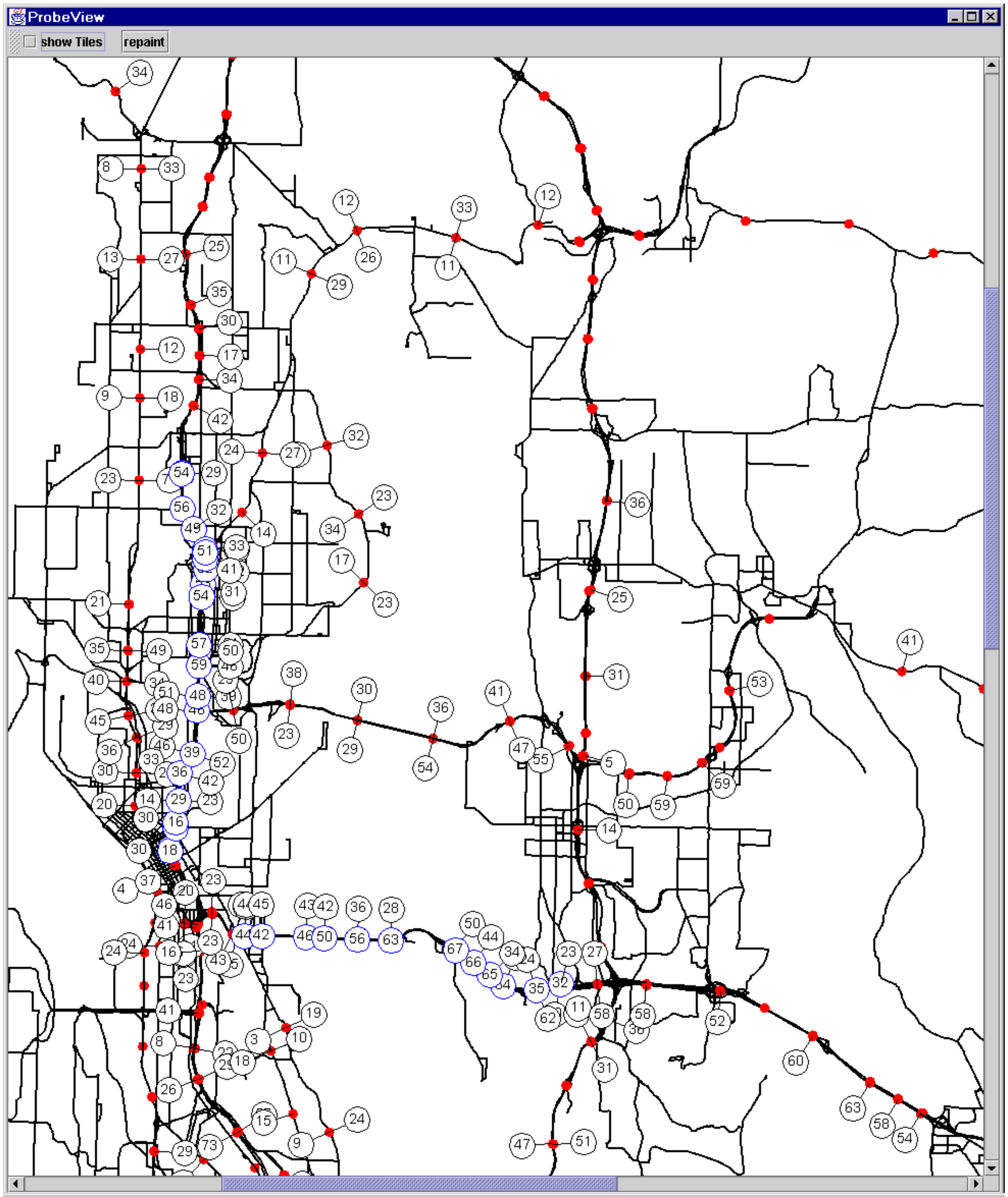

Figure 8: Virtual speed sensors on the ITS Backbone

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 2005/6

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) TRA- 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) Web Services Demonstration