RITA Intelligent Transportation Systems Joint Program Office

National Deployment Estimate of the Metropolitan ITS Infrastructure:

Updated with 2010 Deployment Data, 7th Revision

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Notice

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16. Abstract

The purpose of this report is to provide a summary and back-up information on the methodology, data sources, and results for the estimate of Intelligent Transportation Systems (ITS) capital expenditures in the top 75 metropolitan areas as of FY 2010. It is the 7th in a series of estimates that are derived from an initial forecast of the full deployment cost for ITS in Metropolitan areas across the United States, and subsequent ITS Deployment Survey results.

From 1997 to 2010 the ITS deployment among the 75 largest metropolitan areas has increased 185% or $12 billion from $6.5 billion to $18.5 billion (and $3 billion since 2005). This highlights the significant and steady growth in ITS expenditures that has occurred since the first ITS deployment survey was conducted in 1997.

The deployments made through 2010 represent 41.9% of the estimated total costs for full ITS deployment in these areas. In other words, the average market penetration of deployed ITS is about 42% in the typical large metropolitan area of the United States. From 2005 through 2010 roughly $600 million per year was invested on average by the largest 75 metropolitan areas. On average this equates to about $8.0 million per year per large metropolitan area without any special deployment program. This includes investments from all sources including federal, state, local and private funding.

Note, this work provides a conservative estimate of the ITS deployment since it does not include ITS investments in small and medium urban or rural areas. Nor does it capture reinvestment and the evolution of ITS systems to the next generation of technologies once the initial deployment has been made.

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Executive Summary

The purpose of this report is to provide a summary and back-up information on the methodology, data sources, and results for the estimate of Intelligent Transportation Systems (ITS) infrastructure capital expenditures in the top 75 metropolitan areas as of FY 2010. It is the 7th in a series of estimates that are derived from an initial forecast of the full deployment cost for ITS in Metropolitan areas across the United States, and subsequent ITS Deployment Survey results.

In 1995, FHWA developed estimates of the potential market size of the core ITS infrastructure ITS elements in the largest metropolitan areas in the United States and what it would cost to reach 100 percent deployment for each ITS element. (FHWA, Office of Traffic Management and Intelligent Transportation Systems, 1995). First carried out in 1997, the ITS Deployment Surveys provide a means to estimate the costs that have been expended to date based upon the deployment levels reported for each metropolitan area (Gordon, Steve, and Trombly, Jeffrey, 1998 – 2011). To calculate the amount that has been expended in a particular year, the cost to reach 100 percent potential deployment for each ITS element is multiplied by the percent that has been deployed to date from the deployment survey. The various values are then summed to obtain total expended costs.

This analysis has most recently been carried out based upon the 2010 ITS Deployment Survey (Gordon, Steve and Trombly, Jeff, 2011). Figure ES- 1 shows the most recent results and the growth in ITS infrastructure investments in the 75 largest metro areas since 1997.

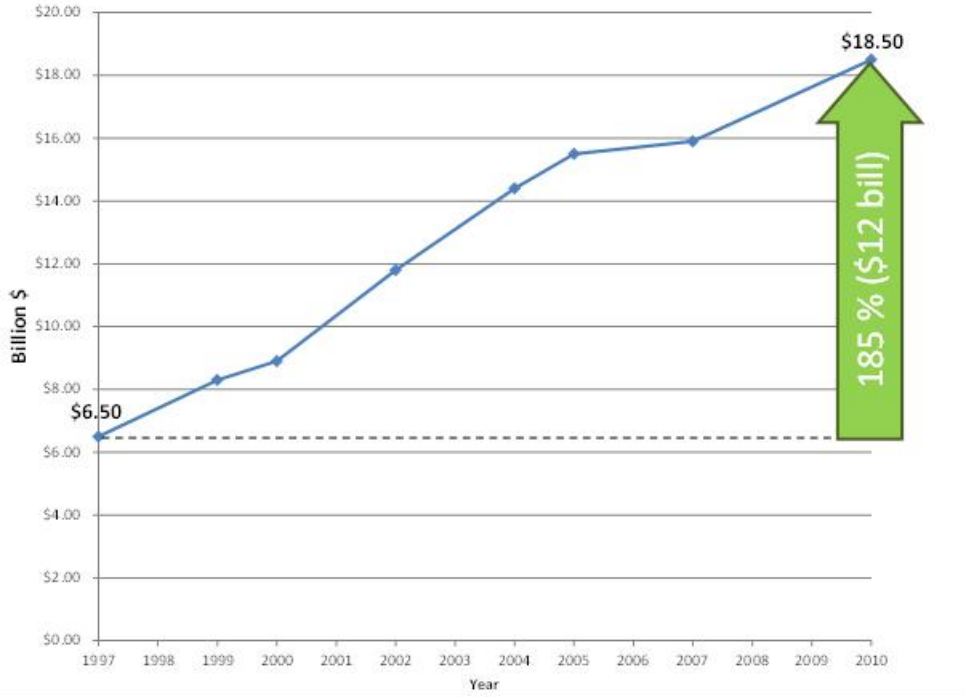

Figure ES- 1 Total National Deployment Investment on ITS in the 75 Largest Metro Areas Through 2010

Highlights from the update are:

- **$18.5 Billion** has been expended in ITS infrastructure investments (capital costs) in the nation's 75 largest metropolitan areas through FY 2010
- Infrastructure investment **increased 185 percent** ($12 Billion) from FY 1997 to FY 2010. Figure ES- 1 highlights the significant and steady growth in ITS expenditures that has occurred since 1997 when the first ITS deployment survey was conducted.
- In FY 2010 ITS deployment in the largest 75 Metro Areas **reached 42 percent** of potential deployment across all ITS Infrastructure elements. In 2005 it was 35 percent and in 2007 36 percent.
- **Investment in ITS infrastructure has continued to grow** despite the recent significant downturn in the nation's economy and public resources for transportation.
    - From FY 2005 through FY 2010, roughly $600 million per year was invested on average by the largest 75 metropolitan areas, or approximately $8.0 million per year per large metro area.
    - From FY 2007 through FY 2010 investments continued at roughly $650 million per year on average across the largest 75 metro areas, or approximately $8.6 million per year per large metro area.

  This highlights the importance placed on ITS systems by local and state agencies that continue to look to ITS to improve their operations and increase capacity when infrastructure investments may be infeasible or impractical.
- Large markets and new groundbreaking technologies (video surveillance, smart cards systems, etc.) have driven the expenditures in the ITS elements with the highest expenditures in FY 2010. These include Surveillance-Arterials at $3.9 billion, Communication-Freeways at $3.18 billion, and Electronic Fare Payment Systems at $2.78 billion.
- Large potential markets such as Surveillance-Arterials represent where infrastructure investments **could** take place and not where they **should** take place. There are many miles of arterials or low volume freeways for which there are not cost effective infrastructure based ITS solutions. New mobile technologies such as probe vehicle data collection are starting to offer cost effective options for these network segments.
- All of the ITS elements have significant percent deployment through 2010 ranging from Freeway Management@Roadside at 19 percent to Electronic Toll Collection Systems at 94 percent.
- Lack of local budget availability or transformative technological advances may have limited the growth in other ITS Elements such as Communications-Arterials and Traffic Signal Controls, both of which only grew from a 47 percent deployment in FY 1997 to 54 percent deployment in FY 2010.
- Several ITS elements appear to be slowing in deployment as they reach saturation at their maximum desirable deployment levels. Electronic Toll Collection Systems is at 94 percent deployment. Other ITS elements such as Freeway Management@Roadside and Emergency Response Centers remained stable in FY 2010. This reinforces other recent analyses that conclude that many ITS markets are maturing (Pace, David, et.al, July 2011).

- Even though these markets seem to be reaching their saturated level, additional deployment expenditures are anticipated as first generation ITS systems become obsolete and need to be replaced by newer more advanced technologies.

Further details are provided below and throughout the main body of the report.

The expenditures made through 2010 represent 41.9 percent of the estimated total capital ITS infrastructure costs for reaching 100 percent of the potential ITS deployment in these areas. In other words, the average market penetration of deployed ITS is about 42 percent in the typical large metropolitan area of the United States. From FY 2005 through FY 2010, roughly $600 million per year was invested on average by the largest 75 metropolitan areas[1]. On average this equates to about $8.0 million per year per large metropolitan area, without any special deployment program. This includes investments from all sources including federal, state, local and private funding.

Of course, the ITS infrastructure elements vary greatly with respect to their potential market size, level of deployment, and recent growth. This is illustrated in Figure ES- 2 that shows the ITS Infrastructure expenditures and percent deployment by ITS element through 2010.

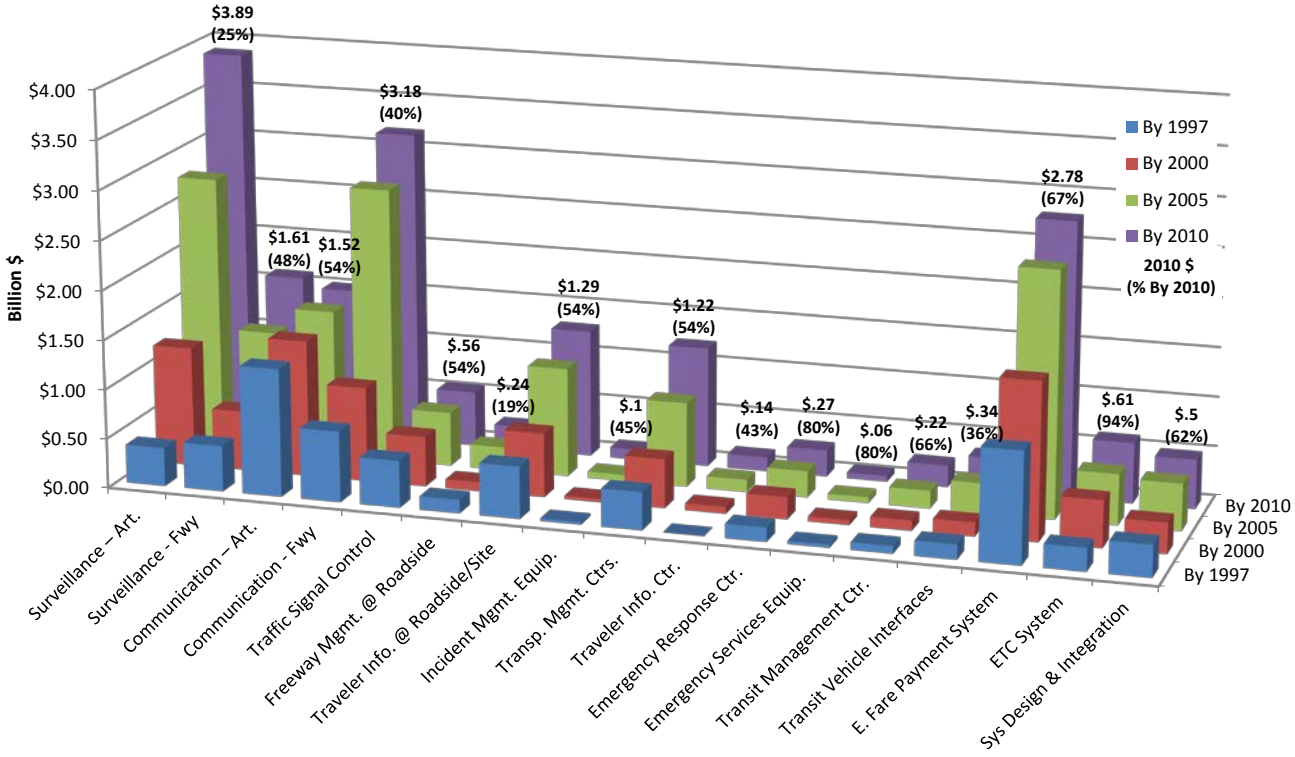

Figure ES- 2 ITS Costs Expended By ITS Element in the 75 Largest Metro Areas Through 2010

The three ITS elements with the highest expenditures in the top 75 largest metropolitan areas through 2010 are Surveillance-Arterials at $3.9 billion, Communication-Freeways at $3.18 billion, and Electronic Fare Payment Systems at $2.78 billion. The large expenditures for these ITS elements are due to both their potential markets and their rapid growth. These are also the ITS elements with the largest potential markets ($15.3, $8.0, and $4.2 billion respectively), and as shown in Figure ES- 2,

[1] Note, that this under-estimates total ITS investment since it does not include small urban or rural areas, freight, CVO, etc.

significant growth. As the focus on real time congestion management increased and new technologies (such as CTV) evolved Surveillance-Arterials alone, grew from FY 1997 to FY 2010 by $3.5 billion or over 900 percent.

It is important to point out that these ITS Elements with the highest overall expenditures (due to their large overall potential markets) also have relatively low or medium percent deployment levels. Surveillance-Arterials has only a 25 percent deployment level in FY 2010. This is due to the many miles of arterials that could be equipped for surveillance, and while it may be possible it may not be cost effective to do so. Newer methods of data collection not dependent on infrastructure investments, such as the use of GPS and vehicle probes may be starting to provide viable alternatives. For example, the I-95 Coalition recently found that freeway surveillance based upon private sector probe data had a life cycle cost of approximately 25 percent of the life cycle cost of previously used methods of up to $50,000 per mile (I-95 Coalition, 2011). These newer mobile technologies are not captured in this analysis.

Likewise, Communications-Freeway is at 40 percent deployment and Electronic Fare Payment Systems is at 67 percent. Communications along the most congested central freeway segments in urban areas are now likely to be in place. It can be also argued that the initial deployment of electronic fare payment systems has taken place in most of the major metropolitan areas, and the systems are now in the process of upgrading and extending their systems to cover all vehicle types. In fact in the very large metropolitan areas percent deployment is over 80 percent (Gordon, Steve and Trombly, Jeff, 2011).

Also noteworthy are the ITS Elements that did not seem to change significantly between FY 1997 and FY 2010. Communications Arterials and Traffic Signal Controls both had relatively high percent deployment of 47 percent in FY 1997 and only grew to 54 percent in FY 2010. This may be due to both local budget limitations and lack of transformative technological advances in these markets during this time period.

Other ITS elements may have a significant growth in percent deployment, but have a much smaller potential market resulting in lower overall expenditures. Traveler Information Centers went from being non-existent in 1997 to a 43 percent deployment but only had expenditures by FY 2010 of $0.14 billion. Likewise, Surveillance–Freeways grew $1.2 billion (250 percent) from FY 1997 to FY 2010, yet only reached $1.61 billion in expenditures due to its smaller potential market ($3.35 billion).

All of the ITS elements have significant percent deployment through 2010, though some also seem to be slowing down or have reached their limit in deployment. The ITS element with the highest percent deployment is Electronic Toll Collection Systems at 94 percent also has a small potential market ($ 0.65 billion) and little room for further growth. The Emergency Response Centers and Emergency Services Equipment also have high percent deployment (80 percent) and seem to be slowing down and reaching their maximum desirable levels. On the other hand, Freeway Management@Roadside has the lowest percent deployment of 19 percent, but has been stable or even declined slightly in FY 2010. One explanation for this is it is comprised mostly of ramp metering systems, HOV, and lane control technologies that are not applicable under all conditions. The operation of existing ramp meter systems has also declined in some regions in the country and may be being replaced by other types of traffic management. All these examples reinforce recent studies by the Volpe Center indicating that many ITS markets are reaching a mature state (Pace, David, et.al, July 2011). Even though these markets seem to be reaching their saturated level, additional deployment expenditures are anticipated as first generation ITS systems become obsolete and need to be replaced by newer more advanced technologies.

Last, It is important to note that this methodology only provides a rough estimate of ITS expenditures in large metropolitan areas. It is therefore a very conservative estimate of total ITS expenditures and does NOT include the costs of ITS deployment in smaller metropolitan or rural areas, planning studies, preliminary engineering, research, operational, maintenance, or replacement costs. Nor does it include additional costs for the evolution of ITS systems to the next generation of ITS technologies once they have been initially deployed.

Chapter 1: Introduction and Background

The purpose of this memorandum is to provide a summary and back-up information on the methodology, data sources, and results for the estimate of capital Intelligent Transportation Systems (ITS) expenditures in the top 75 metropolitan areas as of FY 2010. It is the 7th in a series of estimates that are derived from an initial forecast of the full deployment cost for ITS in metropolitan areas across the United States, and subsequent ITS Deployment Survey results. The initial working paper estimated expenditures as of FY 1997 based upon the original 1997 ITS Deployment Survey results (Cheslow, Melvyn, September, 1999). Deployment survey results from 1999, 2000, 2002, 2004, 2005, and 2007 were incorporated into subsequent estimates of ITS expenditures to date and the investments remaining to reach 100 percent of potential deployment of each ITS element (See Cheslow, Melvyn and Staples, Barbara, 2000, 2001, 2003, Staples Barbara, 2005, 2006, and Hatcher, Greg, 2009). With the 2010 deployment survey results available, the national deployment cost estimate can be updated again.

In 1995, FHWA developed estimates of the potential market size of the core ITS infrastructure ITS elements in the largest metropolitan areas in the United States and what it would cost to reach 100 percent deployment in each market. (FHWA, Office of Traffic Management and Intelligent Transportation Systems, 1995). These initial estimates provided a base case maximum deployment cost if ITS was deployed everywhere it could possibly be deployed (e.g. providing freeway surveillance for every mile of freeway in a Metropolitan Area). This included: defining the different ITS elements and their cost components; determining average unit costs for each component; obtaining data and estimating the potential market size of each ITS element if it was deployed everywhere it could be deployed (e.g. the miles of freeway and surveillance equipment per mile in an metropolitan area); and carrying out the cost calculations. Based upon this approach the initial National Capital Costs to reach 100 percent of potential deployment of ITS were $74.4 billion for all 300 metropolitan areas and $31.5 billion for the largest 75 metropolitan areas. The current 100 percent potential deployment estimate for the 75 largest metropolitan areas based upon updated unit costs and market size data is $42.2 billion (Staples, Barbara, 2006). Note, that these estimates represent what could be deployed and not necessarily what will or should be deployed across the Nation.

First carried out in 1997, the ITS Deployment Surveys provide a means to estimate the costs that have been expended to date based upon the deployment levels reported for each metropolitan area (Gordon, Steve, and Trombly, Jeffrey, 1998 – 2011). To calculate the amount that has been expended in a particular year, the cost to reach 100 percent potential deployment for each ITS element is multiplied by the percent that has been deployed to date from the deployment survey. The various values are then summed to obtain total expended costs.

The focus of recent revisions to the National ITS Deployment Costs has been on updates to the costs for the top 75 metropolitan areas. In 1997, the ITS deployment costs expended in the top 75 metropolitan areas were $6.5 billion. Through 2010, this has increased to an estimated $18.5 billion (a 185 percent increase). This represents 41.9 percent of the estimated total costs to reach 100 percent of potential ITS deployment in these areas. In other words, the average market penetration of

deployed ITS is about 42 percent in the typical large metropolitan area of the United States. More information is provided in the results section.

A summary of the methodology used to update the estimates using the 2010 deployment data is provided in the next section followed by the results section. Additional information on the past updates can be found in the references.

Chapter 2: Methodology and Data Sources

The basic approach to calculating the amount of capital investment in ITS infrastructure by the top 75 metropolitan areas is presented below:

a) For each ITS application area: take the quantities associated with 100 percent potential deployment in the average large metropolitan area (of the top 75 areas) and multiply it by the unit costs associated with the ITS application. Multiply this cost to reach 100 percent potential deployment by the average percent market penetration (of the top 75 metropolitan areas) from the ITS Deployment Survey of the equipment associated with that application.

   The ITS deployment data, based on a survey sponsored by the ITS Joint Program Office, are used to estimate the quantities and the market penetration (or percent deployed) of various equipment packages and applications (Gordon, Steve, Trombly, Jeffrey, 2011). In rare instances the percent deployed for an equipment package may have decreased in 2010 from previous survey results (e.g. Freeway Management@Roadside: Ramp Meter Systems). In these cases, the higher percent deployed represents the cost that has been expended in the past even though current deployment may be lower, and, therefore, the highest percent deployed from the 2005, 2007, or 2010 ITS Deployment surveys was used.

b) Total (sum) the investment estimates in each ITS element or application area to get a total for the average large metropolitan area;

c) Multiply the total capital ITS investment estimates for the average large metropolitan area by 75 to get a total for the top 75 metropolitan areas.

Table 3 provided in the Results Section shows the detailed calculations for the 2010 estimates. For more details on the methodology used, see previous working papers as indicated in the list of references. Prior to this report, the latest updates of this estimate were made using national deployment survey data collected in FY 2007 (Hatcher, Greg, 2009) and FY 2005 (Staples, Barbara, 2005).

Chapter 3: Results (2010 Deployment Data)

As shown in Figure 1, from FY 1997 to FY 2010 the ITS costs expended in the nation's 75 largest metropolitan areas has increased 185 percent from $6.5 billion to $18.5 billion. This highlights the significant and steady growth in ITS expenditures that has occurred since the first ITS deployment survey was conducted in 1997.

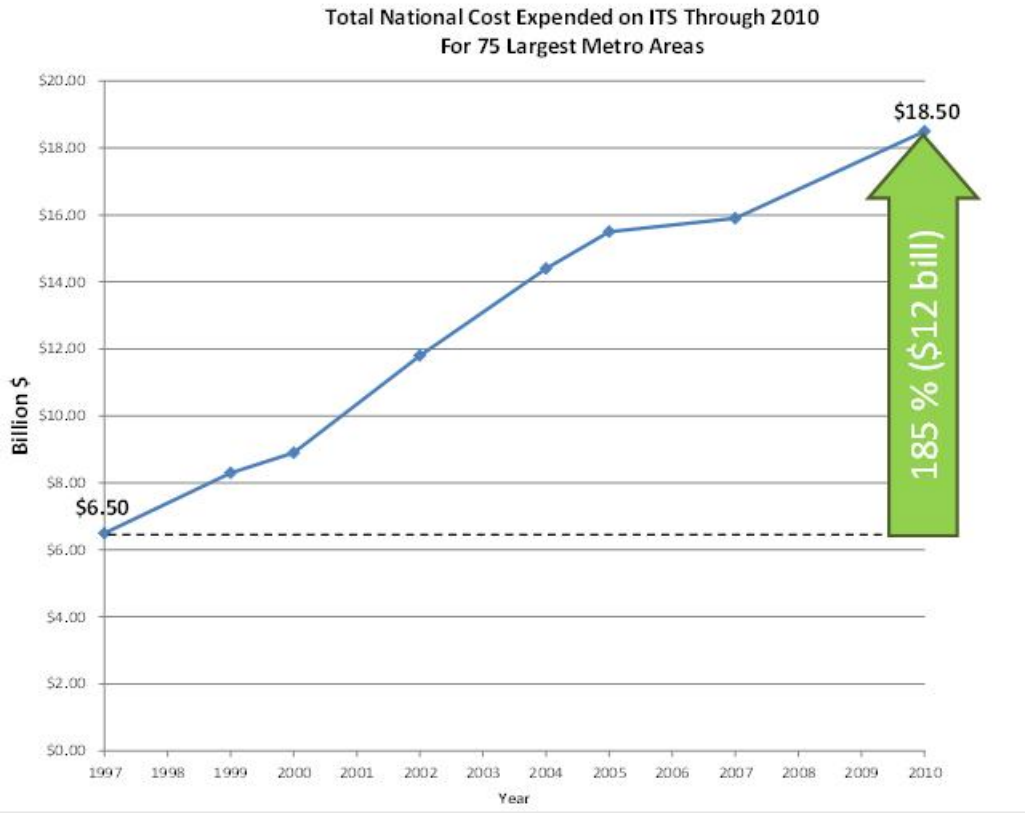

Figure 1 Total National Deployment Investment on ITS in the 75 Largest Metro Areas Through 2010

Summary results from FY 2005, FY 2007, and FY 2010 are shown in Table 1, which indicates the amount of investment already made (total national capital ITS infrastructure cost expended) and the investment that is still needed to reach 100 percent of the potential ITS infrastructure deployment for all ITS elements. Note that in most cases, the amount of ITS infrastructure that should be deployed in an urban area is not equal to the amount that could be deployed. The investment still to be made (total national capital cost remaining) as indicated in the table assumes that urban areas would deploy 100 percent of what could be deployed. To show how the level of "full" deployment might affect the estimate of investment needs, a simple parametric analysis of the values that would reflect different

levels for "full" market penetration (representing different levels for how much ITS should be deployed) has been conducted in the previous working papers.

Table 1 Summary Results for Total Deployment Investment Made and Investment Remaining to Reach 100% Potential Deployment through FY 2005, FY 2007, and FY 2010 for Top 75 Large Metropolitan Areas

National Summary – Total ITS Infrastructure Deployment Estimated by Year For Top 75 US Metropolitan Areas	2005	2007	2010
Percent Deployment Investment:	35.0%	35.9%	41.9%
Estimated Total Infrastructure Costs to reach 100% of potential deployment in the 75 Largest Metro Areas ($B)	$44.2	$44.2	$44.2
Total Deployment in the 75 Largest Metro Areas ($B)	$15.5	$15.9	$18.5
Total Investment Remaining to reach 100% of potential deployment in the 75 Largest Metro Areas ($B)	$28.7	$28.3	$25.7

The results on a national level indicate that an estimated $18.5 billion in ITS infrastructure deployment costs have already been expended by the top 75 metropolitan areas. This represents 41.9 percent of the estimated total costs to reach 100 percent of potential ITS deployment in these areas. In other words, the average market penetration of deployed ITS is about 42 percent in the typical large metropolitan area of the United States.

Investment in ITS infrastructure has continued to grow despite the recent significant downturn in the nation's economy and public resources for transportation. Through fiscal year 2005, an estimated 35 percent of the total investment costs to reach 100 percent potential deployment had been expended. The level of growth in investments in ITS deployment as estimated between 2005 and 2010 for large metropolitan areas was $3.0 billion (from 35 percent to 41.9 percent market penetration), or about $600 million per year. This equates to about $8.0 million per year per large metropolitan area on average. If only the period from FY 2007 to FY 2010 is considered the average investment per year for all 75 metro areas increases to roughly $650 million, or approximately $8.6 million per year per large metro area. This highlights the importance placed on ITS systems by local and state agencies that continue to look to ITS to improve their operations and increase capacity when infrastructure investments may be infeasible or impractical.

The reader should be advised that this methodology only provides a rough estimate of ITS expenditures in large metropolitan areas. It is equally important to recognize what is NOT included in the estimate from a national perspective. This estimate does NOT include the costs of ITS deployment in smaller metropolitan or rural areas, planning studies, preliminary engineering, research, operational, maintenance, or replacement costs. Nor does it include additional costs for the evolution of ITS systems to the next generation of ITS technology once they have been initially deployed.

Of course, the ITS infrastructure elements vary greatly with respect to their potential market size, level of deployment, and recent growth. This is illustrated in Table 2 and Figure 2 and Figure 3 that show the ITS percent deployment and expenditures by ITS element through 2010.

As shown in Figure 2 , all of the ITS elements have significant percent deployment through 2010 (ranging from Freeway Management@Roadside at 19 percent to Electronic Toll Collection Systems at 94 percent), though some also seem to be slowing down or have reached their limit in deployment. The ITS element with the highest percent deployment is Electronic Toll Collection Systems at 94 percent also has a small potential market ($ 0.65 billion) and little room for further growth. The

Emergency Response Centers and Emergency Services Equipment also have high percent deployment (80 percent) and seem to be slowing down and reaching saturated deployment levels (see Table 2). On the other hand, Freeway Management@Roadside has the lowest percent deployment of 19 percent, but has been stable or even declined slightly in FY 2010. One explanation for this is it is comprised mostly of ramp metering systems, HOV, and lane control technologies that are not applicable under all conditions. The operation of existing ramp meter systems has also declined in some regions in the country and may be being replaced by other types of traffic management. All these examples reinforce recent studies by the Volpe Center indicating that many ITS Markets are reaching a mature state (Pace, David, et.al, July 2011). Even though these markets seem to be reaching their saturated level, additional deployment expenditures are anticipated as first generation ITS systems become obsolete and need to be replaced by newer more advanced technologies.

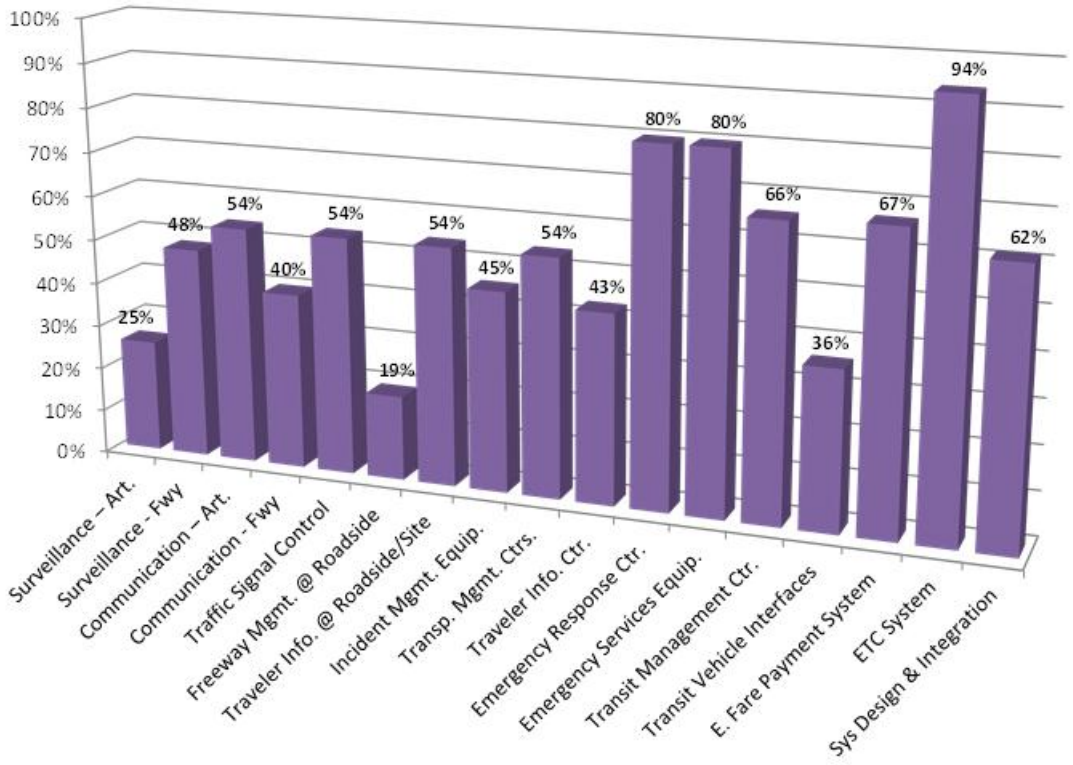

Figure 2 Percent Deployed By ITS Element in Large Metropolitan Areas Through 2010

As shown in Table 2 and Figure 3 the three ITS elements with the highest expenditures in the 75 largest metropolitan areas through 2010 are Surveillance-Arterials at $3.9 billion, Communication-Freeways at $3.18 billion, and Electronic Fare Payment Systems at $2.78 billion. The large expenditures for these ITS elements are due to both their potential markets and their rapid growth. These are also the ITS elements with the largest potential markets ($15.3, $8.0, and $4.2 billion respectively), and as shown in Figure 1, significant growth. As the focus on real time congestion management increased and new technologies (such as CTV) evolved Surveillance-Arterials alone, grew from FY 1997 to FY 2010 by $3.5 billion or over 900 percent.

It is important to point out that these ITS elements with the highest overall expenditures due to their large overall potential markets also have relatively low or medium percent deployment levels. Surveillance-Arterials has only a 25 percent deployment level in FY 2010. This is due to the fact that

there are many miles of arterials that could be equipped for surveillance and while it may be possible it may not be cost effective to do so.

Newer methods of data collection not dependent on infrastructure investments, such as the use of GPS and vehicle probes may be starting to provide viable alternatives. For example, the I-95 Coalition recently found that freeway surveillance based upon private sector probe data had a life cycle cost of approximately 25 percent the life cycle cost of previously used methods that had life cycle costs of up to $50,000 per mile (I-95 Coalition, 2011). These newer mobile technologies are not captured in this analysis.

Table 2 Percent Deployed and ITS Investment by ITS Element through 2010

ITS ELEMENTS	Investment in 75 Largest Metro Areas ($Billion) By 1997	By 2000	By 2005	By 2010	Potential Market Total ($Billion)	% Deployed By 2010
Surveillance – Arterials	$0.39	$1.21	$2.76	$3.89	$15.27	25%
Surveillance – Freeways	$0.46	$0.60	$1.22	$1.61	$3.35	48%
Communication – Arterials	$1.29	$1.38	$1.49	$1.52	$2.81	54%
Communication – Freeways	$0.72	$0.95	$2.78	$3.18	$7.95	40%
Traffic Signal Control	$0.47	$0.51	$0.55	$0.56	$1.03	54%
Freeway Management @ Roadside	$0.14	$0.09	$0.24	$0.24	$1.24	19%
Traveler Information @ Roadside/Site	$0.53	$0.65	$1.10	$1.29	$2.39	54%
Incident Management Equipment	$0.03	$0.03	$0.06	$0.10	$0.23	45%
Transp. Mgmt. Ctrs	$0.38	$0.50	$0.86	$1.22	$2.25	54%
Traveler Information Center	$0.00	$0.07	$0.13	$0.14	$0.33	43%
Emergency Response Center	$0.14	$0.22	$0.27	$0.27	$0.34	80%
Emergency Services Equipment	$0.03	$0.05	$0.06	$0.06	$0.07	80%
Transit Management Center	$0.08	$0.10	$0.18	$0.22	$0.33	66%
Transit Vehicle Interfaces	$0.15	$0.14	$0.30	$0.34	$0.95	36%
Electronic Fare Payment System	$1.12	$1.59	$2.48	$2.78	$4.16	67%
Electronic Toll Collection System	$0.23	$0.47	$0.51	$0.61	$0.65	94%
Sys Design & Integration	$0.32	$0.31	$0.47	$0.50	$0.81	62%
Total	$6.5	$8.9	$15.5	$18.5	$44.2	42%

Likewise, Communications-Freeway is at 40 percent deployment and Electronic Fare Payment Systems is at 67 percent. Communications along the most congested central freeway segments in urban areas are now likely to be in place. It can be also argued that the initial deployment of electronic fare payment systems has taken place in most of the major metropolitan areas, and the systems are now in the process of upgrading and extending their systems to cover all vehicle types. In fact in the very large metropolitan areas percent deployment is over 80 percent (Gordon, Steve and Trombly, Jeff, 2011).

Also noteworthy are the ITS Elements that did not seem to change significantly between FY 1997 and FY 2010. Communications Arterials and Traffic Signal Controls both had relatively high percent deployment of 47 percent in FY 1997 and only grew to 54 percent in FY 2010. This may be due to both local budget limitations and lack of transformative technological advances in these markets during this time period along with a significant installed base. Significant new features or cost savings

may have to be enabled by new ITS technologies before local agencies decide to invest more or change from what they already have deployed.

Other ITS elements may have a significant growth in percent deployment, but have a much smaller potential market resulting in lower overall expenditures. Traveler Information Centers went from being non-existent in 1997 to a 43 percent deployment but only had expenditures by FY 2010 of $0.14 billion. Likewise, Surveillance–Freeways grew $1.2 billion (250 percent) from FY 1997 to FY 2010, yet only reached $1.61 billion in expenditures due to its smaller potential market ($3.35 billion).

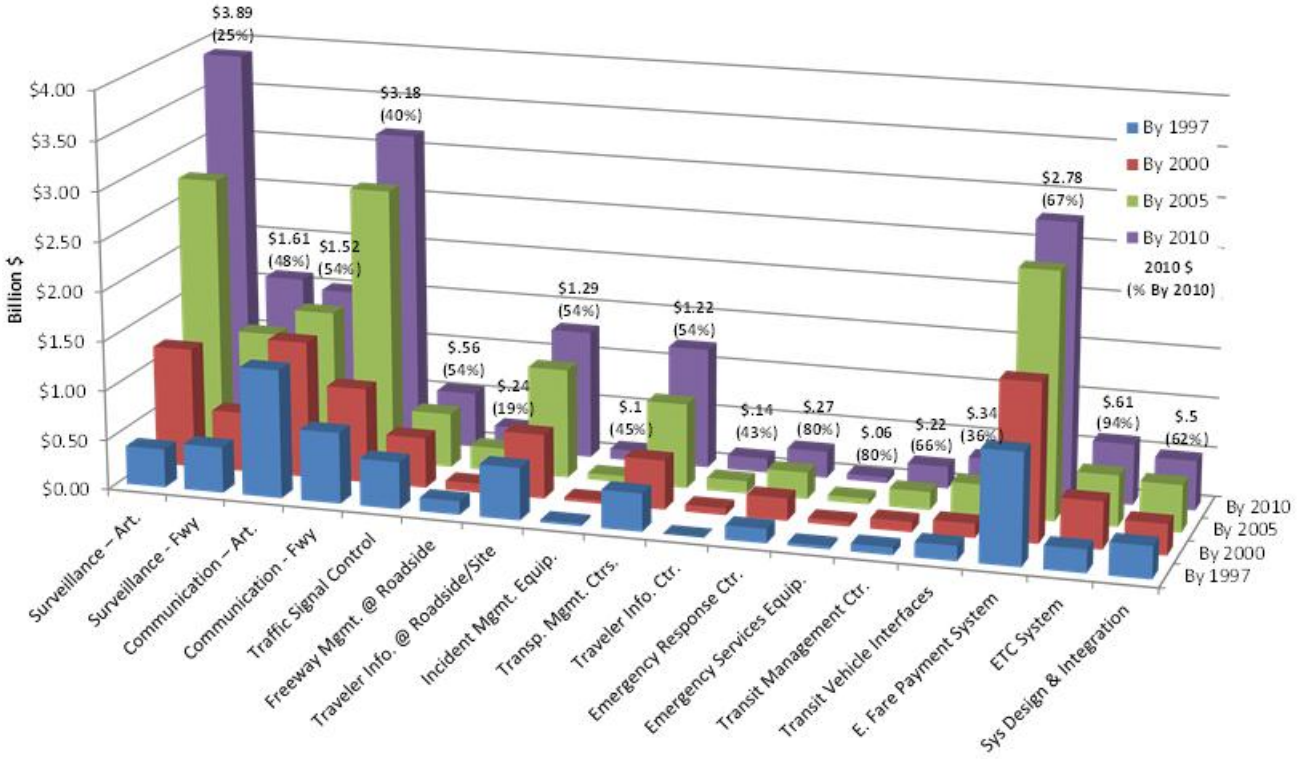

Figure 3 ITS Costs Expended By ITS Element in the 75 Largest Metro Areas Through 2010

Details of the calculations made to arrive at the above results are shown in

Table 3, which uses 75 large metropolitan areas as the basis of the estimate. Information in the tables is based on the "average" large metropolitan area. The key parameter that has changed from the previous estimates is the percent deployed column, which is now based on updated 2010 deployment data. The quantities to reach 100 percent potential ITS deployment and unit costs for each item have been combined in the "Capital Costs Large ($K)" column. For more information about these calculations and assumptions, see the working papers listed in the references.

Table 3 Detailed Breakdown of the Capital ITS Infrastructure Investment Estimated for the Average Large Metropolitan Area and Total for 75 Large Metropolitan Areas (Updated with 2010 Deployment Data)

ITS ELEMENTS	CAPITAL COSTS LARGE ($K)	% DEPLOYED BY 2010	CAPITAL COSTS EXPENDED BY 2010 ($K)	REMAINING CAPITAL COSTS ($K)
SURVEILLANCE - ARTERIALS				
Loop Detectors per signal per approach lane	$33,000	50%	$16,500	
Other arterial loop detectors	$3,960	50%	$1,980	
Overhead Point Detectors [NEW]		50%	$0	
Processor (170 series), 1 per direction per half mile (Arterials) [NEW]	$62,500	50%	$31,250	
CCTV Cameras per signalized intersection	$6,250	10%	$625	
CCTV pole and foundation [NEW]	$4,500	10%	$450	
Video Image Processing/intersection	$10,000	10%	$1,000	
AVI equip. to identify priority veh./intersection [NEW]	$82,500			
AVL equip (to supplement GPS)/site [NEW]	$825			
SURVEILLANCE - ARTERIALS	$203,535		$51,805	$151,730
SURVEILLANCE - FREEWAYS				
Loop Detectors per fwy lane per half mile	$7,040	54%	$3,802	
Overhead Point Detectors [NEW]	$0	54%	$0	
Data Station (Fwy), 1 per half mile [NEW]	$20,000	54%	$10,800	
CCTV Cameras per freeway mile	$10,000	40%	$4,000	
CCTV pole and foundation [NEW]	$7,200	40%	$2,880	
Emissions & Environmental Sensors	$400			
SURVEILLANCE - FREEWAYS	$44,640		$21,482	$23,158
COMMUNICATION - ARTERIALS				
Twisted-pair to Signals (per intersection)	$37,500	54%	$20,250	
Wireless radio [NEW]	$0		$0	
Leased line to signals [NEW]	$0	54%	$0	
Leased line to video [NEW]	$0		$0	
COMMUNICATION - ARTERIALS	$37,500		$20,250	$17,250
COMMUNICATION - FREEWAYS				
Fiber-Optic Cable/ freeway mile	$106,000	40%	$42,400	
Fiber-optic hub - 1 per 5 mi. of fiber [NEW]	$0	40%	$0	
Leased line to video [NEW]	$0	40%	$0	
COMMUNICATION - FREEWAYS	$106,000		$42,400	$63,600

ITS ELEMENTS	CAPITAL COSTS LARGE ($K)	% DEPLOYED BY 2010	CAPITAL COSTS EXPENDED BY 2010 ($K)	REMAINING CAPITAL COSTS ($K)
TRAFFIC SIGNAL CONTROL				
Central Computer System (Closed Loop) NEW	$0			
Central Computer System (Distributed) NEW	$0			
Master controllers for distributed system (1 per 25 intersections) [NEW]	$1,000			
Signal controller replacement per intersection [NEW]	$0			
Signal controller upgrade (per intersection)	$12,500			
Signal Preemption: Transit, Emergency Vehicle, RR [NEW]	$250			
TRAFFIC SIGNAL CONTROL	$13,750	54%	$7,425	$6,325
FREEWAY MANAGEMENT @ ROADSIDE				
HOV lane control & monitoring equip.	$2,500	9%	$225	
Ramp Meter Systems (per interchange)	$14,000	21%	$2,940	
FREEWAY MANAGEMENT @ ROADSIDE	$16,500		$3,165	$13,335
TRAVELER INFORMATION @ ROADSIDE/SITE				
Full Matrix VMS & Controllers (without structure)	$7,000			
Overhead Structure[Separated out]	$10,500			
Hybrid VMS with structure (Arterials)	$2,000			
Fixed HAR & Controllers	$200			
Callboxes: each direction per half-mile	$8,000			
Kiosks	$4,200			
TRAVELER INFORMATION @ ROADSIDE/SITE	$31,900	54%	$17,226	$14,674
INCIDENT MANAGEMENT EQUIPMENT				
Portable VMS	$600	48%	$288	
Portable HAR	$450	48%	$216	
Special Pickup Trucks (w. Dyn. Route Guidance)	$2,000	44%	$880	
O & M Personnel	$0	48%	$0	
INCIDENT MANAGEMENT EQUIPMENT	$3,050		$1,384	$1,666
TRANSP. MGMT. CTRS				
Software (various)/TMC	$600			
Computers & Hardware/TMC	$680			
Software (various)/TMC	$220			
Facilities & Communications/TMC	$4,000			

ITS ELEMENTS	CAPITAL COSTS LARGE ($K)	% DEPLOYED BY 2010	CAPITAL COSTS EXPENDED BY 2010 ($K)	REMAINING CAPITAL COSTS ($K)
O & M Personnel/TMC	$0			
TRANSP. MGMT. CTRS	$30,000	54%	$16,200	$13,800
TRAVELER INFORMATION CENTER				
Computers and Hardware	$102			
Software (various)	$300			
Facilities & Communication (stand-alone)	$4,000			
O & M Personnel	$0			
TRAVELER INFORMATION CENTER	$4,402	43%	$1,893	$2,509
EMERGENCY RESPONSE CENTER				
Computers & Hardware	$400			
Software (various)	$70			
Facilities & Communications (stand-alone)	$4,000			
O & M Personnel	$0			
EMERGENCY RESPONSE CENTER	$4,470	80%	$3,576	$894
EMERGENCY SERVICES EQUIPMENT				
Cellular radio, comm. services per vehicle	$990			
EMERGENCY SERVICES EQUIPMENT	$990	80%	$792	$198
TRANSIT MANAGEMENT CENTER				
Computers & Hardware	$340			
Software (various)	$120			
Facilities & Communication (stand-alone)	$4,000			
O & M Personnel	$0			
TRANSIT MANAGEMENT CENTER	$4,460	66%	$2,944	$1,516
TRANSIT VEHICLE INTERFACES				
Cellular radio, display, etc per vehicle	$12,600	36%	$4,536	
AVI Transponder (on Signal Priority routes) [NEW]	$0		$0	
In-vehicle AVL equip. per vehicle [NEW]	$0	66%	$0	
TRANSIT VEHICLE INTERFACES	$12,600		$4,536	$8,064
ELECTRONIC FARE PAYMENT SYSTEM				
In Transit Mgmt Center				
Central Computer System	$3,000	70%	$2,100	
Training & Documentation	$80	70%	$56	
At ticketing site				

ITS ELEMENTS	CAPITAL COSTS LARGE ($K)	% DEPLOYED BY 2010	CAPITAL COSTS EXPENDED BY 2010 ($K)	REMAINING CAPITAL COSTS ($K)
Station Controller [DELETE]	$0			
Ticket Office Machine & Validator	$2,440	70%	$1,708	
Ticket Vending Machines	$30,000	70%	$21,000	
Turnstile [DELETE]	$0			
On Transit Vehicles				
Bus Farebox	$14,000	70%	$9,800	
Smart Card	$6,000	40%	$2,400	
Sys Engineering. Etc. [MOVED]				
ELECTRONIC FARE PAYMENT SYSTEM	$55,520		$37,064	$18,456
ELECTRONIC TOLL COLLECTION SYSTEM				
AVI Plaza Computer equipment	$2,600			
Manual AVI (per lane)	$2,190			
Automatic AVI (per lane)	$1,050			
Manual Automatic AVI (per lane)	$1,875			
AVI Dedicated (per lane)	$480			
Express AVI (per lane)	$480			
ELECTRONIC TOLL COLLECTION SYSTEM	$8,675	94%	$8,155	$521
SYS DESIGN & INTEGRATION				
TMC, TIC, EMC, Transit MC	$5,400	53%	$2,862	
Electronic Fare Payment Sys	$5,400	70%	$3,780	
SYS DESIGN & INTEGRATION	$10,800		$6,642	$4,158
TOTAL PER LARGE METRO AREA	$588,792		$246,938	$341,854
Percent Capital Cost Expended Through 2010:			41.9%	
NUMBER OF LARGE METRO AREAS:	75			
				Totals ($B)
TOTAL NATIONAL CAPITAL COST FOR ALL LARGE METRO AREAS				$44.2
TOTAL NATIONAL COST EXPENDED BY 2010 FOR ALL LARGE METRO AREAS				$18.5
TOTAL NATIONAL CAPITAL COST REMAINING FOR ALL LARGE METRO AREAS				$25.6

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APPENDIX A. List of Acronyms

Acronym	Description
$K	Thousand Dollars
AVI	Automatic Vehicle Identification
AVL	Automatic Vehicle Location
CCTV	Closed Circuit Telivision
FWY	Freeway
FY	Fiscal Year
GPS	Geographic Positioning System
HAR	Highway Advisory Radio
ITS	Intelligent Transportation Systems
JPO	Joint Program Office
O&M	Operations & Maintenance
RR	Railroad
TMC	Transportation Management System
VMS	Variable Message Sign

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