Connected Vehicles and Government

A Catalyst To Unlock the Societal Benefits of Transportation

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The idea of connecting vehicles is gaining momentum. Many stakeholders intuitively see the benefits of connecting vehicles and have started to develop business cases for their respective domains, including the automotive and insurance industries, government, and service providers. This paper is part of a series of Points of View from Cisco's Internet Business Solutions Group (IBSG) analyzing the business case for connected vehicles from all of these perspectives.[1] The series explores the broad societal and business costs of current models of personal transportation, and how connected vehicles can create new value while transforming outdated approaches. It also discusses how automotive manufacturers can reduce the cost of serving their customers and tap new revenue pools by connecting vehicles on a unified communications platform. In this paper, we focus on the implications of connected vehicles for government and society. We look at the opportunities to unlock billions of dollars in value by encouraging smart, connected drivers, understanding smart road pricing, and providing ubiquitous connections to other vehicles and a smart traffic infrastructure.

Paying the Price To Drive Smoothly and Safely

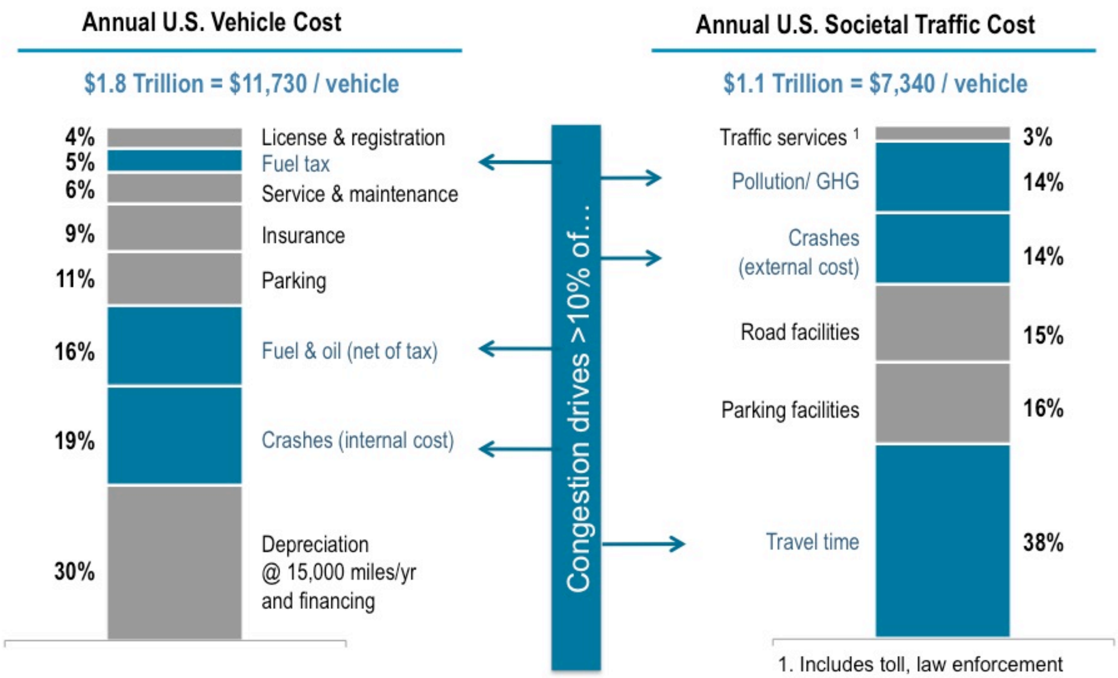
Connecting vehicles and road/traffic operations opens opportunities for new "public services" business models that have the potential to reduce significantly the $1.1 trillion societal cost of personal mobility in the United States[2] (see Figure 1).

Road and traffic operations are typically tax-financed public services with three major shortcomings:

- We consume as much as we can because we perceive them as "free."
- Because the true cost of the inflated demand is not recovered, the public service provider is underfunded.
- The resulting demand/supply imbalance cripples road infrastructure and significantly inflates the societal cost of mobility.

In the United States, about 25 percent of major roadways are in poor condition, and 25 percent of U.S. bridges are either in need of significant repair or too narrow to handle traffic. Increasing demand is stressing the already fragile system even further. From 1990 to 2007, vehicle miles traveled increased 41 percent, a number that is expected to grow an additional 38 percent—from 2.9 trillion to 4.2 trillion vehicle miles—by 2030. Over the past five years, the cost of road improvement increased 55 percent. As a result of these many factors, two to three times the available annual budget of $90 billion to $100 billion is needed to improve conditions.[3]

Figure 1. Annual U.S. Vehicle Cost Totaled $2.9 Trillion in 2010. This Equals Nearly $12,000 per Passenger Vehicle, Plus Another $7,000+ Borne by Society.



Sources: Victoria Transport Policy Institute, AAA, U.S. Department of Transportation, Cisco IBSG, 2010

During the same time frame, the real value of the motor fuel tax base has gradually eroded, as it is charged on a cent-per-gallon basis rather than on a percentage of the price. In the future, increasing fuel economy standards and displacement of the traditional internal combustion engine will reduce the motor fuel tax base even more.[4]

It is possible to address this situation by imposing special taxes or fees that reflect the true societal cost of personal transportation—and by selectively privatizing road, traffic, and parking operations to bring road demand and pricing into a societal balance. Cisco IBSG suggests that vehicle connectivity can act as a catalyst to help pay for the true societal costs of personal transportation, while unlocking additional benefits.

Connecting for Smart Road Pricing

One of the most frequently asked questions in the industry is, "What is the 'killer application' for connected vehicles?" The answer may, in fact, be a "savior application."

Ubiquitous vehicle connectivity combined with differentiated payment algorithms could create a smart road pricing system that charges a fairer market price for road usage than a motor fuel tax or mileage-based system could ever accomplish. Different prices for driving—based on time of day, occupancy, congestion, speed, weight, road type, fuel economy, or emissions—could provide smart incentives for drivers and road operators to balance supply and demand more effectively. Overly stressed parts of the road system would dynamically command price premiums to flexibly divert demand to less costly routes and, eventually, to finance the elimination of bottlenecks.

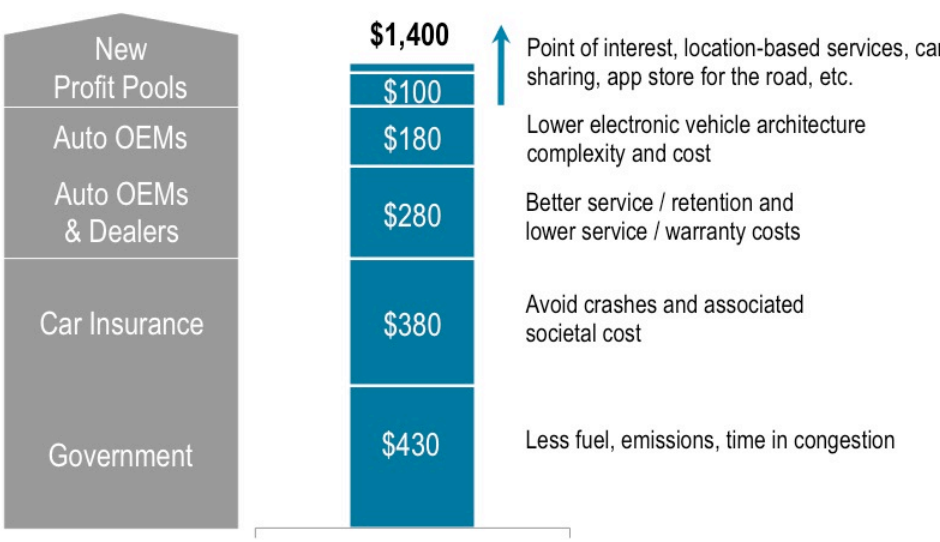
Figure 2. The "Savior Application": Connecting for Smart Road Pricing.

Source: Cisco IBSG, 2011

The Cisco IBSG Automotive and Research & Economics practices estimate that annual benefits could amount to $1,400 per connected vehicle (see Figure 3). Governments and insurance companies can directly unlock $810 of these benefits by putting a fair price on the true societal cost of traffic congestion and stressed traffic assets, thus saving lives and regaining many precious hours of otherwise wasted time.

Introducing ubiquitous smart road pricing, perhaps in the form of a vehicle-miles-traveled (VMT) tax, could also serve as a "soft mandate" for vehicle connectivity. Initially, vehicle owners could be given the option to connect their vehicles and pay the VMT tax instead of paying license fees and gasoline taxes. Those who elect not to connect would continue to pay standard license fees and fuel taxes, perhaps at a higher rate to better reflect the true societal cost and provide additional incentives to opt-in. New vehicles would be connected by mandate, which would eventually result in nearly universal participation.

Figure 3. Annual Benefits per Connected Passenger Vehicle, by Source.



Source: Cisco IBSG, 2011

This "soft mandate" would not only generate $810 in annual benefits per vehicle through reduction of traffic congestion and crashes, but would also help unlock the remaining $590 in benefits for the automotive industry, and new business models for smart-connected-vehicle service providers.[5]

Roadside Equipment Business Hub

The technology to enable VMT taxes and intelligent traffic systems (ITS) is available today. Vehicle manufacturers are starting to build connectivity into their vehicles, although the current focus is on connecting vehicles to conventional voice and data networks. However, $810 of the $1,400 benefit pool largely depends on connecting vehicles to other vehicles and to an intelligent traffic infrastructure that has yet to be built.

Figure 4 illustrates that connecting vehicles to roadside infrastructure in the United States could be a profitable business at a cost of only a tenth of a cent per vehicle mile traveled, even if applied only to urban miles.

Figure 4. Potential Cost of Roadside Equipment Business Would Be $12 to $18 Annually per Vehicle.

	CapEx ($M)	P&L ($M)
Initial Total 5-Year RSE Investment (10-Yr. Depr.)	$6,260	$626
Repair/ Replacement	$620	$62
Operating Expenses		$440
Subtotal RSE Cost		**$1,128**
Hypothetical Margin	100%	$1,128
Revenue Required To Fund RSE Business		**$2,256**

Cost per vehicle-mile traveled: 1/10th of 1¢

$18 per vehicle

Sources: Vehicle-Infrastructure Integration (VII) Initiative, Benefit-Cost Analysis, Version 2.3, U.S. DOT, 2008; Cisco IBSG, 2010

While cost estimates for connecting vehicles to infrastructure have varied over time, the U.S. Department of Transportation (DOT) recently estimated $6.2 billion for installing roadside equipment (RSE) infrastructure and another $600 million per year for repair and replacement. In addition, U.S. DOT estimates include depreciation over 10 years plus $440 million for annual operating costs.[6] Assuming a 100 percent profit margin, $2.3 billion in revenues is needed to fund a profitable RSE business. This works out to $12 to $18 per vehicle per year to fund an intelligent traffic infrastructure that would bring us another step closer to enjoying annual benefits of up to $1,400 for each connected vehicle.

As a government agency, a private company, or a public-private partnership, the RSE business could provide smart VMT services to federal, city, and state governments, or to private toll road operators. Automating payments through vehicle connectivity would reduce the cost of toll operations, which typically consume 30 percent to 50 percent of revenues. Manual toll collection costs in the range 20 to 30 cents per transaction, while transponder transactions cost three to 10 cents per transaction.[7]

RSE business operations could be upgraded to provide ITS management as a service to the same customer base. The business model could be funded by a premium on VMT/toll collection or as tiered, value-added service plans for drivers. For example, a basic passive ITS package might include local intelligent speed adaptation with vehicle-to-infrastructure link, in-vehicle dynamic speed-limit information, and dynamic signal speed-limit information. At the high end, a premium dynamic ITS package could offer central, real-time traffic management with dynamic speed-limit optimization, dynamic signal optimization, unique dynamic rerouting, and “pay for speed,” where customers would pay a premium to drive at higher speed on electronically dedicated fast lanes.

The RSE business could use vehicle probe and sensor data to optimize road maintenance through early detection and remediation of obstacles such as snow, ice, fog, and road damage. The Smartway system in Tokyo, Japan, for example, detects approximately 50,000 obstacles per year on the Metropolitan Expressway alone. This translates into 140 driver warnings daily, or one warning every 10 minutes, all of which reduce the risk of crashes and congestion.[8] Furthermore, the RSE operation would help enable the full potential of ubiquitous, advanced crash notification services by accelerating the performance of first responders, thereby reducing the probability of additional crashes and congestion.

Another promising business model expansion is connected parking operations. Cities like Denver and Washington, D.C., are currently transitioning from single- to multispace meters; Chicago and Los Angeles are pushing cashless payments; San Francisco-based Streetline is equipping parking spaces with sensors to provide availability information on electronic signs and via smartphone applications; and New York City’s PARK Smart program is charging different prices at different times.[9] Combining the best of these promising innovations with vehicle connectivity could enable a new parking business model with the potential to significantly reduce urban traffic—7 to 12 percent of which is created by people looking for parking. It could also dramatically boost the profitability of parking operations by improving utilization of parking assets, by introducing a market-based pricing system, and by reducing the cost of taking payments.

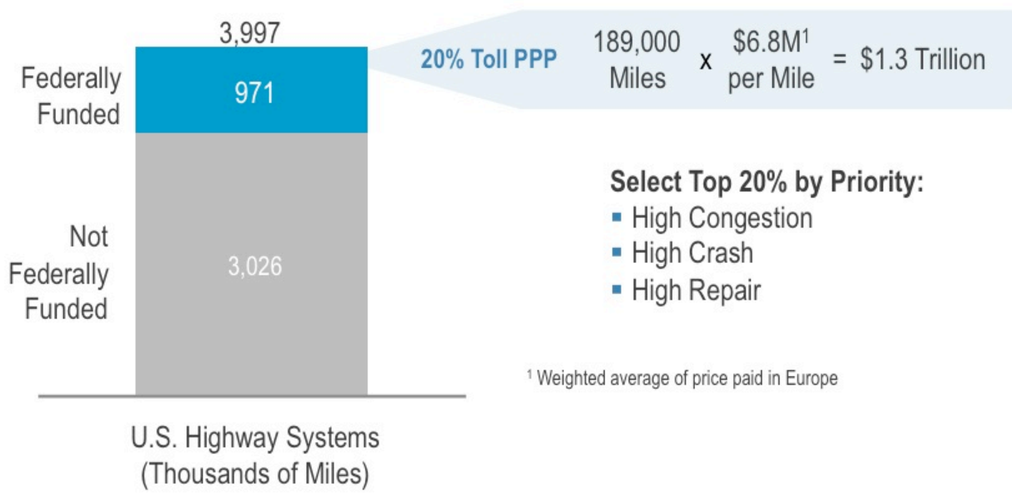
To support latency-sensitive crash and safety applications of ITS, the RSE network probably will depend on dedicated short-range communications (DSRC). However, the incremental cost of adding Wi-Fi to RSE could be minimal compared to the benefits it can unlock for the operators of RSE networks and the communities in which they are built. In the not-so-distant future, RSE installations will evolve to become local gateways that optimize communication among vehicles, with the cloud, and among many systems in their immediate proximity, including intelligent traffic systems, wireless sensors, and location-based services. This represents a strategic opportunity and risk for incumbent service providers.[10] Service providers could grasp the opportunity to build and operate the connected vehicle and roadside networks, or leave the investment to new entrants such as telematics service providers, road and traffic operators, insurance companies, and government agencies.

Public-Private Partnerships To Fund RSE Infrastructure

Another route to finance the required RSE infrastructure could be public-private partnerships or privatization of parts of government-owned road, traffic, and parking operations.

Approximately 34 percent of the highway system across Europe is toll-operated, compared to 3 percent of the national highway system in the United States. As shown in Figure 5, privatizing just the top 20 percent of the nearly 1 million miles of the U.S. national highway system that is at least partially funded with federal money could yield $1.3 trillion in sales proceeds—and reduce the corresponding public highway budget by $35 billion to $40 billion per year.[11] In addition, private road operators or public-private partnerships typically reduce investment and operating costs by 15 percent to 20 percent,[12] yielding savings of $5 billion to $8 billion per year. Just one year of these operational savings is sufficient to fund the entire RSE infrastructure investment in the United States. These savings could also help fund urgently needed road improvements as part of the privatization deal.

Figure 5. Tolling and Privatization Scenario for U.S. Highway System.



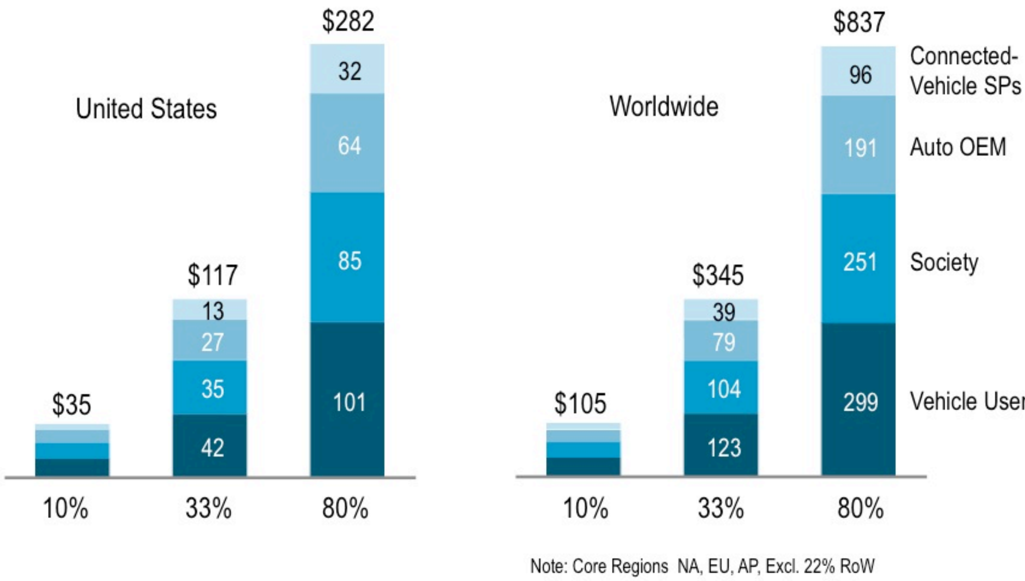
Source: An Analysis of the Current Investment Trend in the U.S. Toll Road Sector, MIT, 2008; Cisco IBSG, 2010.

Cities, states, and the federal government could take this concept even further and privatize the top 20 percent of the U.S. road, traffic, and parking operations based on congestion, crashes, and repair needs. The government could use the proceeds to pay back some of its debt, alleviate strained budgets, and—by participating in the profits of the newly formed enterprise—catch up on the repair backlog and finance the RSE infrastructure to reap the benefits of connecting vehicles. Assuming that this would connect a third of the U.S. vehicle population, the $1,400 in annual benefits per connected vehicle could create 400,000 new jobs in the emerging connected vehicle industry in the United States.[13]

The Bottom Line: Scaling the Business of Connecting Vehicles

Even if we succeed in connecting only part of our vehicle population, the potential value for stakeholders is tremendous. Connecting one-third of all vehicles has the potential to unlock more than $100 billion of value in the United States and nearly $350 billion globally (see Figure 6).

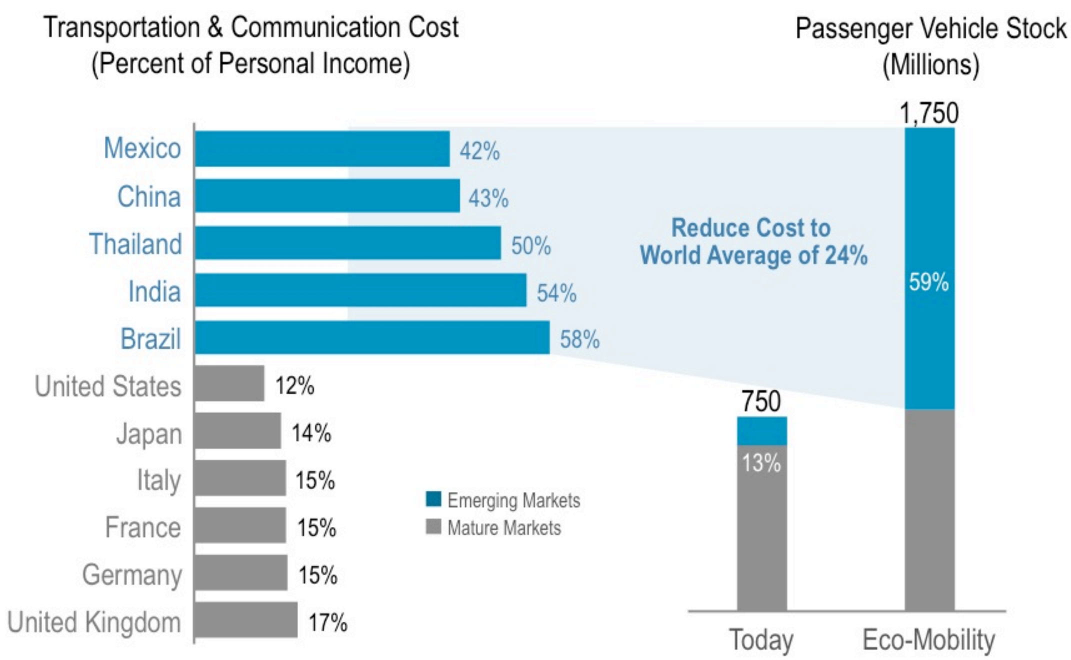
Figure 6. Benefits of Connecting All Vehicles per Year, by Penetration ($ Billion).



Source: Cisco IBSG, 2011

Furthermore, as illustrated in Figure 7, reducing the inefficiency and societal cost of personal transportation, along with enabling new business and pricing models, could make mobility affordable for 1 billion more drivers in the world. People in mature markets pay 12 to 17 percent of their personal income for transportation and communication; in emerging markets, people must pay 42 to 58 percent of their income. Reducing this ratio to the world average of 24 percent could sell up to 1 billion more vehicles and boost prosperity in emerging economies.

Figure 7. Transportation Cost, Income, and Vehicle Ownership.



Sources: EIU Data 2009 or latest available; Cisco IBSG, 2010

The tremendous potential of connecting vehicles has unleashed a global race to fund and attract connected vehicle and ITS research projects and proofs of concept.[14] However, unlocking the value of connected vehicles may require policies that reach beyond the trodden path. Moving from concept to reality will require investment in connected vehicle infrastructure by a government agency, a public-private partnership, or a private company. The most direct catalyst could be a "soft" government mandate or the introduction of VMT/smart road pricing. Another option available to cities, states, and the federal government is a public-private partnership or privatization of the top 20 percent of road, traffic, and parking operations based on traffic congestion, crashes, and repair needs. Public seed investment, combined with guaranties for communication frequencies, VMT/smart road pricing, or ITS operations contracts, could provide sufficient incentives for private enterprises and investors to fund and make the connected vehicle infrastructure a business. Even in an era of tight budgets, Cisco IBSG estimates that such a business in the United States could generate one-tenth of a cent per vehicle mile traveled.

Cisco IBSG believes that solving the problem of overcrowded, underfunded roadways will take a coordinated effort among governments, automotive manufacturers, insurance companies, and service providers. Working together, we can create a next-generation transportation business model based on connected vehicles and a smart, connected traffic infrastructure. For more information, see these related papers in the Cisco IBSG Connected Vehicles series:

- "A Business Case for Connecting Vehicles: Executive Summary"
- "Connected Vehicles: From Building Cars to Selling Personal Travel Time Well-Spent"
- "Connected Vehicle Insurance: The Business of Preventing Crashes"
- "Connected Vehicles: Service Providers at a Crossroads"

Cisco IBSG works with customers to develop the underlying business and technology architectures that enable the vision and benefits of connected vehicles.

For more information about "The Business of Connecting Vehicles," please contact:

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Endnotes

1. Other papers in the series include "A Business Case for Connecting Vehicles: Executive Summary," Cisco IBSG, 2011; "Connected Vehicles: From Building Cars to Selling Personal Travel Time Well-Spent," Cisco IBSG, 2011; "Connected Vehicle Insurance: The Business of Preventing Crashes," Cisco IBSG, 2011; and "Connected Vehicles: Service Providers at a Crossroads," Cisco IBSG, 2011.
2. Cisco IBSG estimate based on data from Victoria Transport Policy Institute, AAA, U.S. DOT, 2010. This and all other currency references in this paper are in U.S. dollars.
3. "America's Top Five Transportation Headaches," AASHTO, Victoria Transportation Policy Institute, 2009.
4. "Paying Your Way, Final Report of the National Surface Transportation Infrastructure Financing Commission," February 2009.
5. For more information on new profit pools and other financial benefits, see "From Building Cars to Selling Travel Time Well-Spent," Cisco IBSG, 2011.
6. Vehicle-Infrastructure Integration (VII) Initiative, Benefit-Cost Analysis, Version 2.3, U.S. DOT, 2010.
7. The New Jersey Turnpike Authority, October 2010, http://www.tollroadsnews.com/node/4956
8. Koichi Sakai, Intelligent Transport Systems (ITS) Division, National Institute for Land and Infrastructure Management on the Second International Summit on the State of the Connected Vehicle, September 29, 2010.
9. "'Smart' Parking Meters Catching on Across U.S., *USA Today,* February 24, 2009, http://www.usatoday.com/tech/news/techinnovations/2009-02-23-smartmeters_N.htm
10. For a detailed analysis, see the Cisco IBSG Point of View "Service Providers at a Crossroads," April 2011.
11. "Closing America's Infrastructure Gap: The Role of Public-Private Partnerships," Deloitte, 2007.
12. Ibid.
13. "The Employment Intensity of Economic Growth in the G-7 Countries," Padalino, Samanta, and Marco Vivarelli, 1997, *International Labour Review* 136: 191-213. Assumes 33 percent employment elasticity (more conservative than the 0.5 Padalino evidenced) and the estimated "GDP" value of 33 percent of vehicles connected.
14. "Explaining International IT Application Leadership," Stephen Ezell, Intelligent Transportation Systems, January 2010.

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