Point of View

A Business Case for Connecting Vehicles

Executive Summary

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Cisco Internet Business Solutions Group (IBSG)

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Executive Summary

With soaring fuel prices, urban gridlock, polluted cities, and changing climate, the time is right for a transformational approach to personal transportation. Cisco's Internet Business Solutions Group (IBSG) believes that connecting vehicles internally and externally on a unified communications network platform can help abate many of the personal and societal costs of personal mobility—and create new profit opportunities for many industry players. This executive summary offers an overview of the business case for connecting vehicles. In subsequent papers, we provide a more detailed analysis of the societal and business costs of current personal transportation models, and how connected vehicles can enable new business models and create substantial value for a wide range of businesses and society. We will focus on the implications of connected vehicles for various public and industry stakeholders, and illustrate how public and private collaboration can unlock the billions of dollars of value that vehicle connectivity can create in the global marketplace.

The High Cost of Personal Transportation

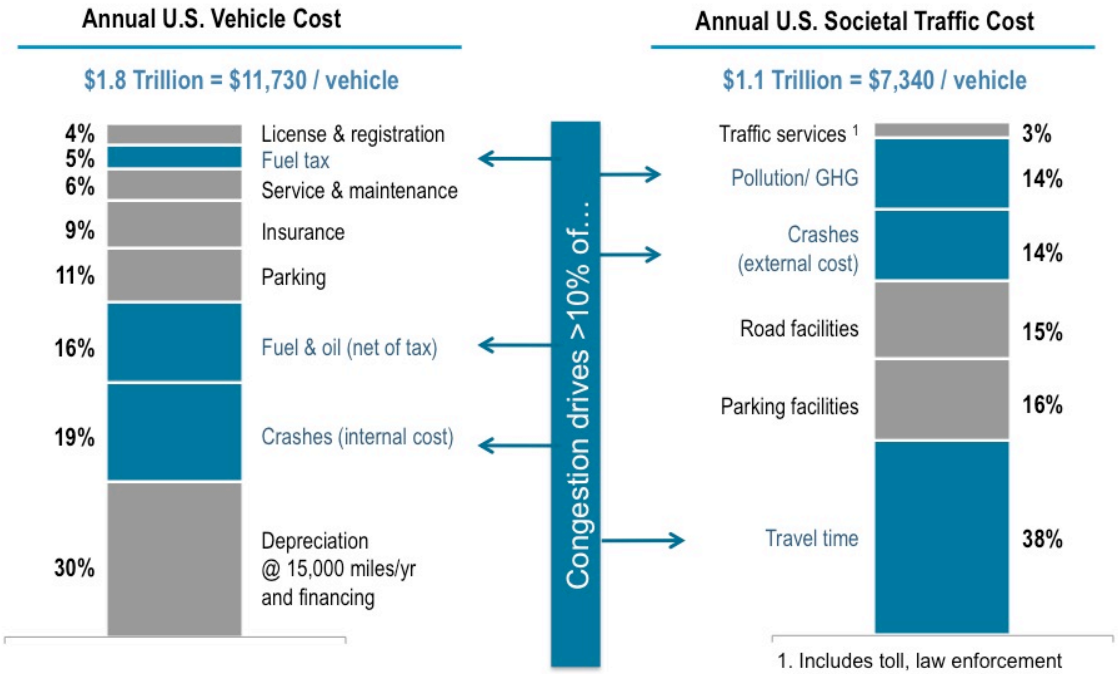
Today's personal transportation system is inefficient and costly, creating problems of global proportions. Every year, 8 million traffic accidents cost 1.3 million lives and injure more than 7 million people. Globally, we waste more than 90 billion hours in traffic jams, generating 220 million metric tons of carbon equivalent and wasting at least $1 trillion, or 2 percent, of the global gross domestic product (GDP).[1]

At the same time, our concept of personal mobility is inherently inefficient, with cars that are chronically overbuilt and underused. As a result, the "real" total cost of personal transportation in the United States alone[2] amounts to $3 trillion per year—not including commercial or public vehicles.[3] Nearly 40 percent of this cost is societal, related to crashes, parking, roads, traffic services, and pollution. These societal costs are, in fact, a hidden "Pigouvian tax"[4] amounting to nearly $7,000 per vehicle per year.

In the United States, congestion alone costs $750 to $950 per vehicle per year, totaling $150 billion to $210 billion.[5] Much of the industry's focus is on building more fuel-efficient vehicles (including electric vehicles), but even the most fuel-efficient car cannot escape the inefficiencies of urban traffic:

- Eleven to 13 percent of time is wasted in urban congestion.
- Seven to 12 percent of urban traffic is created by people looking for parking.
- Ten to 17 percent of urban fuel is wasted at traffic-light stops when there is no cross-traffic.

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

Most Proposed Solutions Are Only Partial

Many efforts are under way to solve the crisis of too many people trying to go too many places on roads overburdened by too many cars:

- **Mass transportation** can help cut pollution and relieve overcrowded roadways, but it is not likely to make a sufficient impact on urban congestion any time soon. Studies show that a major shift from individual to public transportation happens only when it is nearly impossible to travel by car.[6]
- **Electric vehicles:** Assuming the most optimistic projections, electric vehicles will account for only 13 percent of vehicle miles traveled by 2030.[7] Governments have the potential to accelerate adoption by mandating electric vehicles, similar to what China did with electric two-wheelers when nearly 150 Chinese cities banned gasoline-powered bicycles between 1998 and 2006. By 2006, annual sales of electric two-wheelers had grown from less than 1 million to 15 million units.[8] The total reached about 20 million units in 2009 and is projected to grow to 32 million units by 2014.[9] While impressive, it is only a partial solution. Electric vehicles primarily address our energy and pollution problems, but do little to increase traffic throughput of our congested roads.
- **New mobility concepts:** Imagine attaching small, two-person electric vehicles to buses for longer trips, and then detaching them to drive the final miles. Or, envision vehicles powered by induction and external linear motors, with power lines built into roads.[10] These and other seemingly futuristic concepts are likely to emerge within the next three to five years. However, their ultimate feasibility and ability to significantly impact congestion has yet to be validated.

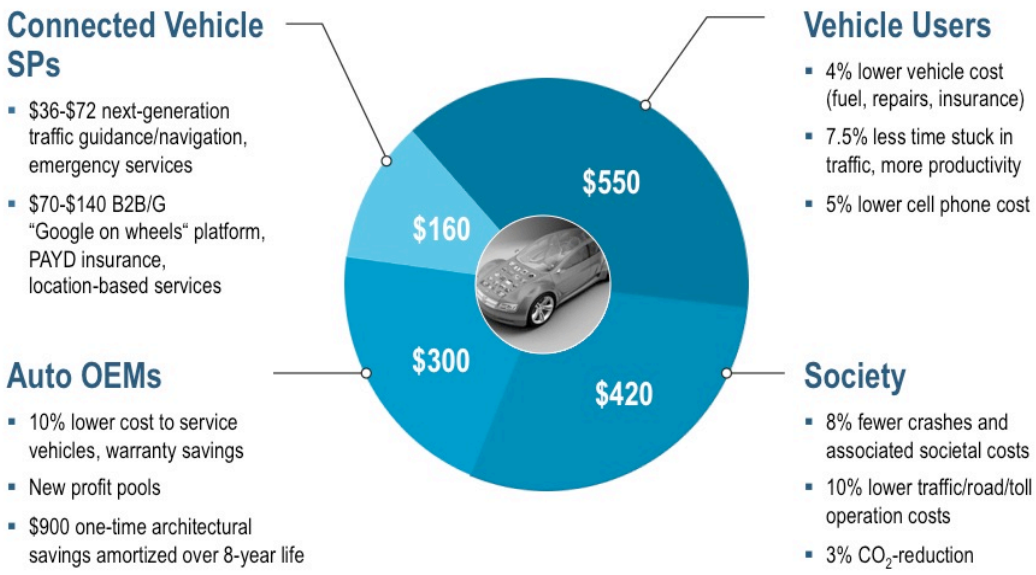
- **Connected vehicles:** Cisco IBSG believes that an integrated automotive information network offers a truly transformative way to alleviate transportation gridlock and enable new mobility concepts. Connected vehicles can intelligently plan out the best route using real-time traffic and weather conditions; help people drive more safely and avoid crashes; and even monitor a driver's health and transmit vital data to first responders after a crash. Connected vehicles have the potential to provide better customer care, lessen insurance costs, ease congestion through "smart road" pricing, and create a cornucopia of new business models and profit pools for various industry players.

Benefits of a Unified Communications Platform

One approach is to combine all of a vehicle's specialized communication systems under a single unified communications platform. Cisco IBSG estimates that by using a multipurpose, on-board communications unit instead of separate devices for audio, telematics, satellite radio, navigation, insurance dongle, Wi-Fi, intelligent traffic system/dedicated short-range communications, tolling, and parking, stakeholders could save approximately 25 percent of the one-time hardware and software costs. They could save an additional 40 percent per year in operating costs by using a single service platform. This would reduce the total one-time costs from $400 to $300, and annual operating costs from $600 to $360.

Above and beyond the cost savings from consolidating a vehicle's communication systems, running transportation systems on networked information opens the door to a host of capabilities that, according to Cisco IBSG analysis, could create an annual benefit pool of $1,400 for each connected passenger vehicle (see Figure 2). This estimate does not include commercial and public vehicles, which cost significantly more to purchase and operate, and also travel more than the average passenger vehicle.

Figure 2. Vehicle Connectivity Will Create a $1,400 Benefit Pool per Vehicle per Year.

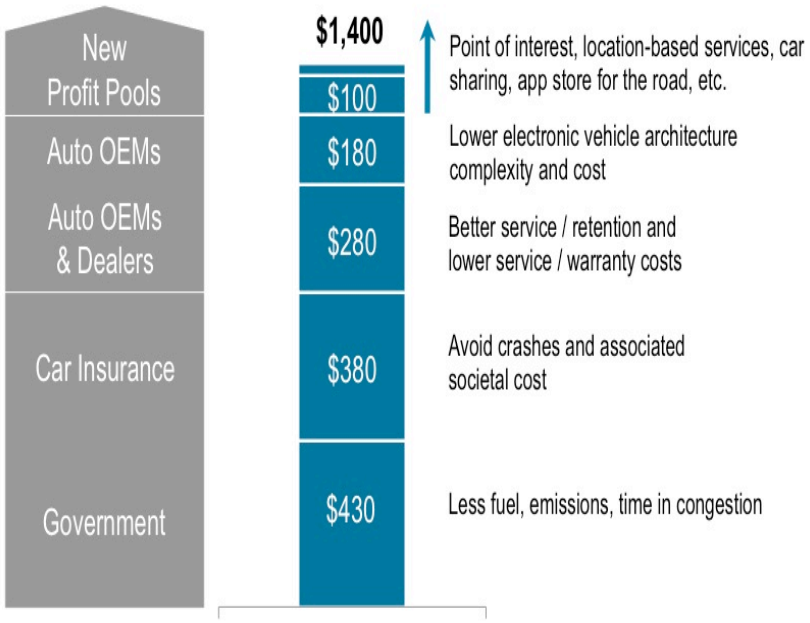


Source: Cisco IBSG Automotive and Research & Economics practices, 2011

This estimate is based on a model that applies conservative estimates of connected-vehicle impact (based on various field tests in the United States, Europe, and Japan) to the full $3 billion annual cost of personal transportation referenced earlier.

While many stakeholders can benefit from connecting vehicles, only a few players are in a position to unlock this value. Figure 3 shows that $810 of the $1,400 connected vehicle benefit pool can be tapped by governments and car insurance companies. The remaining value is controlled by the automotive industry's willingness to invest in vehicle connectivity, and to go from simply building cars to connecting customers, businesses, and governments with a wealth of value-added services. Following is a summary of the roles of the key stakeholders—automotive manufacturers, insurance companies, government, and service providers—in creating value with connected vehicles.

Figure 3. Unlocking the Benefits of Connecting Vehicles: Annual Benefits per Connected Passenger Vehicle.



Source: Cisco IBSG, 2010

Automakers: Selling the Value of Travel Time Well-Spent

Today, the value system of personal mobility is under attack by a new generation of drivers that cherishes social media and technology more than a car.[11] This is scary news for an industry whose products have typically represented the second-largest expense (after home purchases) for an average household over the last century. It is no longer enough to sell personal transportation; people want a personalized driving experience that keeps them connected to everything that is important to them—friends, information, music, maps, schedules, and more.

Connected cars could do for the automotive industry what smartphones did for the phone industry. By integrating smartphone capabilities into vehicle ergonomics with an intuitive, voice-controlled user interface, automakers will not only enhance the in-vehicle experience, but will also promote a hands-free approach that reduces the risks of driver distraction.

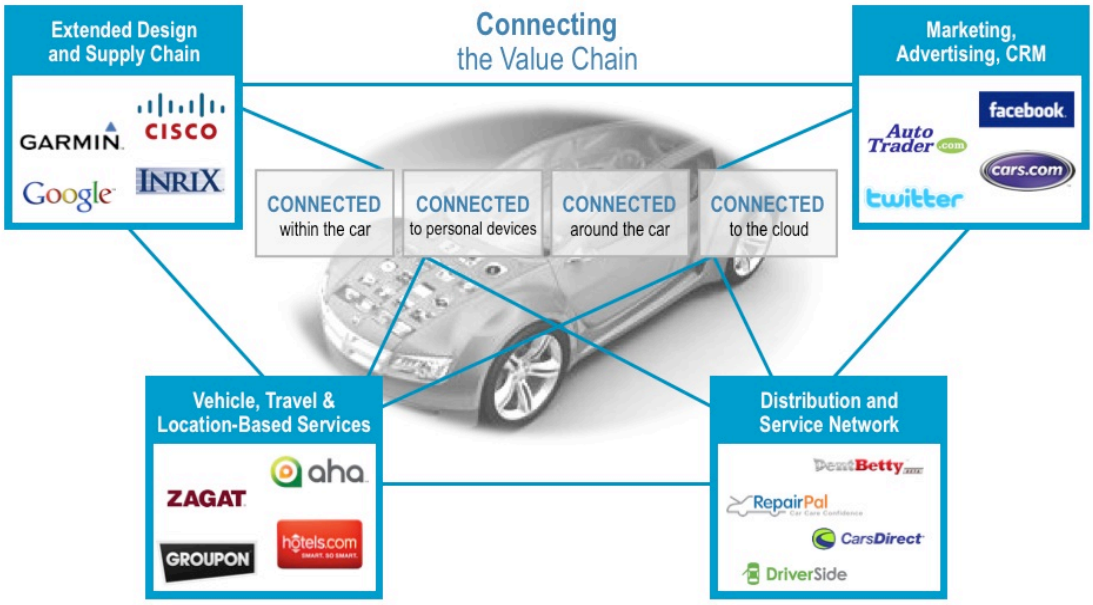
Future cars will augment our driving capabilities and make our travel experience safer and more convenient. While en route, cars will proactively propose to visit friends nearby, restaurants with

special lunchtime deals, hotels at nighttime, and alternate options to use time more productively when congestion is unavoidable.

Ubiquitous vehicle connectivity not only allows automakers to ride the wave of smart mobile technology, but also enables a fundamental strategy shift from merely building cars to selling personal travel time well-spent.

It is not enough merely to connect vehicles to the Internet. To provide the full benefits of vehicle connectivity, the automotive industry also needs to connect the extended value chain (see Figure 4).

Figure 4. From Building Cars to Selling Travel Time Well-Spent.



Source: Cisco IBSG, 2011

The advent of vehicle connectivity opens up a currently untapped treasure chest of new post-sale profit pools, and completely new service and pricing options. Flexible, new service options offer an estimated $680 in annual revenue per vehicle, with $210 gross-margin potential for automotive manufacturers and dealers.[12] Some of the major areas of added value from vehicle connectivity include:

- **Connected vehicle care:** By providing a direct link to vehicles and their owners, automakers can offer remote vehicle health monitoring, maintenance, and customer services.
- **A business-to-business (B2B) or business-to-government (B2G) service platform** can deliver access, data, customer relationship management, and payment services for a captive audience, offering a multitude of opportunities for new business models.
- **Third-generation navigation and location-based services (LBS)** provide real-time traffic guidance, eco-routing, and driver support through an integrated service interface.
- **Connected safety and security** enables monitoring of speed and drive time to enhance safety for inexperienced drivers and to facilitate "pay how you drive" insurance models. Integrating advanced driver assist systems with vehicle-to-vehicle (V2V) and vehicle to-

infrastructure (V2I) communication has the potential to prevent 80 percent of reported crashes, according to National Highway Traffic Safety Administration.[13]

Connectivity will also enable innovative, new business models. It will offer the flexibility to move from rigid, bundled packages to services on-demand, and will also allow completely new pricing models such as micropayments on a per-feature, per-use, per-mile, or per-minute basis. For example:

- **Vehicle connectivity** will accelerate penetration of new business models for car sharing and on-demand driving pioneered by companies like Zipcar, iCarpool, CarBuddy, Zingo Taxi, and car2go.
- **"All inclusive for less" plans** could bundle all the costs of vehicle ownership to provide a "care-free" vehicle ownership experience at a lower cost.
- **"All inclusive pay-as-you-drive for cash" programs** could expand vehicle connectivity by up to 750 million existing vehicles. Automakers buy back vehicles and retrofit them with an on-board connectivity unit in exchange for a connected vehicle services subscription on a per-mile or per-hour basis.
- **Online services** for vehicle owners, drivers, and passengers offer huge opportunities for innovative industry players.
- **An "EcoMiles" loyalty program** could enable customers to earn rewards for every mile driven and receive a report of all their benefits from driving a connected vehicle.

The $210 gross-margin potential for value-added services per vehicle per year adds a significant and recurring profit stream that makes automotive manufacturers less dependent on profits of vehicle sales.

In "Connected Vehicles: From Building Cars to Selling Travel Time Well-Spent," Cisco IBSG provides a detailed perspective on innovative service offerings, where we see the largest profit pools and cost-reduction opportunities, and how car companies can unlock this value by connecting their value chain with those of strategic, value-adding partners.

Connected Vehicle Insurance: The Business of Preventing Crashes

Vehicle connectivity is a strategic asset for the entire car insurance value chain, and the industry is just beginning to explore its full potential. In the United States, the total addressable baseline cost for crashes, insurance premiums, and traffic law enforcement accounts for more than $700 billion every year.[14]

Cisco IBSG estimates that vehicle connectivity has the potential to unlock more than $30 billion in crash-related value for vehicle owners, insurance companies, and society every year:[15]

- **Online services** for vehicle owners, drivers, and passengers offer huge opportunities for innovative industry players.
- **Usage and driver behavior** are the key factors in crashes. An increasing number of insurance companies have started to track mileage to better calibrate premiums with driver risk, and to offer "pay as you drive" (PAYD) policies. The next frontier will be "pay how you drive" (PHYD) models that correlate driver behavior with driver risk.
- **Preventing imminent crashes** is currently not directly influenced by insurance companies, but they could benefit tremendously from connecting vehicles to other

vehicles and to the infrastructure. Field tests in Europe and Japan have shown that 30 to 35 percent of crashes can be prevented by alerting drivers when they are in imminent danger of some of the main crash scenarios, such as rear-ending, running stop signs or red lights, and speeding in curves or bad conditions.

- **A fast and correct response to road accidents** can significantly reduce the number and consequences of severe injuries and fatalities.[16]
- **Claims and investigation costs** can be reduced by automatic transmission of crash data from connected vehicles, by locating and recovering damaged vehicles, and by reducing fraudulent or frivolous claims.

In "Connected Vehicle Insurance: The Business of Preventing Crashes," Cisco IBSG provides a detailed perspective on where we see the largest cost-reduction opportunities, and how insurance companies can tap this value.

Government's Role in Unlocking Benefits of Connected Vehicles

The societal cost of personal mobility in the United States is $1.1 trillion per year.[17] Governments hold the key to unlocking $810 of the $1,400 in value per connected vehicle per year by putting a fair price on the true societal cost of crashes, congestion, and stressed traffic assets. In addition, the same government policies could lay the foundation for the industry to capture $590 for each connected vehicle per year, and spawn 400,000 new jobs.

Road and traffic operations are typically tax-financed, but are overused and underfunded. We consume them freely because we perceive them as "free." Since their true cost is not recovered, the demand/supply imbalance overburdens road infrastructure and public service providers.

It is possible to address this situation by imposing vehicle-miles-traveled (VMT) taxes or "smart road" fees that reflect the true societal cost of personal transportation, as shown in Figure 5.

A smart road pricing system could charge a fairer market price for road use than a motor fuel tax or mileage-based system could ever accomplish. Overly stressed parts of the road system would dynamically command price premiums, not only flexibly diverting demand to less costly routes, but also eventually being used to finance elimination of bottlenecks.

The technology to enable VMT and intelligent traffic systems (ITS) is available today. Vehicle manufacturers are starting to build connectivity into their vehicles, but tapping 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 5. The "Finance Application": Connecting for Smart Road Pricing.

Source: Cisco IBSG, 2010

Cisco IBSG analysis of U.S. Department of Transportation (DOT) data shows that connecting vehicles to a roadside equipment (RSE) infrastructure could be a profitable business at a cost of only a tenth of a cent per vehicle mile traveled in the United States—or $12 to $18 per vehicle per year to fund an intelligent traffic infrastructure.[18]

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. It could warn drivers of upcoming problems and provide advanced crash notification services to first responders, thereby reducing the chance of additional crashes and congestion.

Another promising business model expansion is connected parking operations, which has the potential to reduce urban traffic—7 to 12 percent of which is created by people looking for parking. It could also improve the profitability of parking operations by increasing utilization, introducing a market-based pricing system, and decreasing the cost of taking payments.

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.

Privatizing just the top 20 percent of the U.S. national highway system that is at least partially funded with federal money could yield $1.3 trillion in sales proceeds. Cities, states, and the federal government could take this concept even further and privatize the top 20 percent of U.S. road, traffic, and parking operations based on congestion, crashes, and repair needs. Private road operators or public-private partnerships typically reduce investment and operating costs by 15 to 20 percent,[19] yielding savings of $5 billion to $8 billion per year—enough to fund the entire RSE infrastructure investment in the United States with just one year's worth of operating savings. These savings could also help fund urgently needed road improvements as part of the privatization deal.

The U.S. government, for example, could use the proceeds to pay back some of its debt, alleviate strained public budgets, and—by participating in the profits of the newly formed

enterprise—catch up on the repair backlog and co-finance the RSE infrastructure to reap the benefits of connecting vehicles.

In "Connected Vehicles and Government: A Catalyst To Unlock the Societal Benefits of Transportation," Cisco IBSG provides a more detailed perspective on government options, new public service business models, and financial benefits of connecting vehicles and infrastructure.

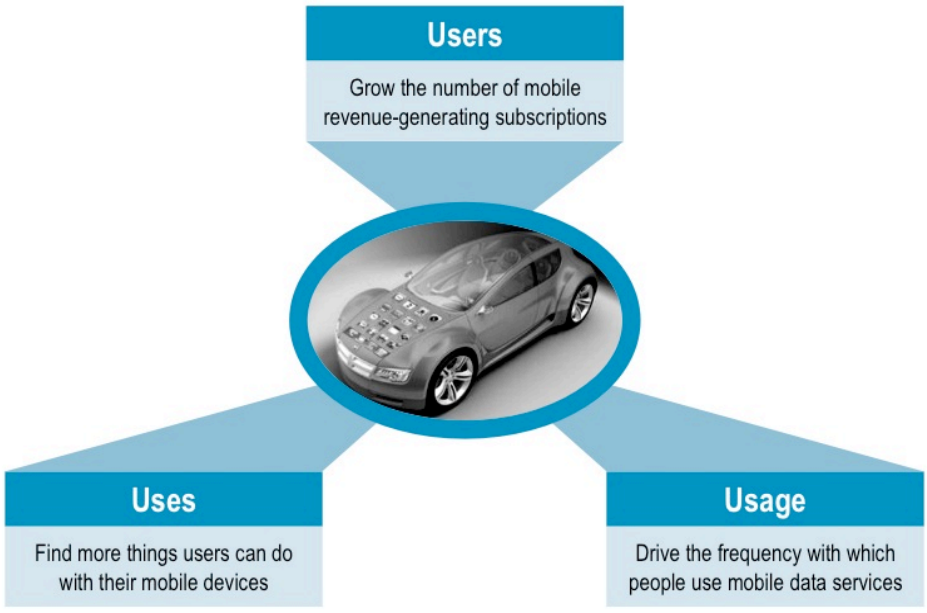
Service Providers at a Crossroads

Over the next decade, nearly 300 million passenger vehicles, or 25 percent of the global vehicle population, will be connected to the Internet and transport more than 400 million gigabytes of data through mobile networks each month. By 2022, the transport of this data volume represents a market potential of more than $50 billion.[20]

However, this opportunity comes with a number of trends that service providers need to carefully factor into their connected vehicle strategies.

Consumers will prefer simply to connect the vehicle as another device to an existing service plan. Hence, automotive manufacturers will need to support multi-carrier capability for connecting vehicles. Part of the connected vehicle data volume will be a mere shift of the usage point from a home network, an office network, or a mobile device to the vehicle.

Figure 6. Connected Vehicle Is an Expanding Opportunity for Carriers.



Source: Cisco IBSG, 2011

Ultimately, vehicles will need to connect via multiple complementary technologies, including 3G, LTE, WLAN, Wi-Fi, and Dedicated Short Range Communication (DSRC). Service providers risk losing business to operators of DSRC roadside networks who add Wi-Fi to their roadside equipment to allow offloading of data-heavy applications.

Ubiquitous connectivity of vehicles while driving at speed across multiple regions will require network-agnostic radio technology.

Cisco IBSG believes that the automotive industry will converge toward a factory-installed on-board unit for providing vehicle connectivity. This unified communications platform will provide the connectivity for basic telematics, voice, and data services, including off-board navigation, traffic information, location-based Internet services, video, and gaming.

These trends and requirements are likely to make connecting vehicles a multi-carrier and multi-technology play, and will drive the emergence of carrier- and technology-agnostic automatic radio switching technology. Service providers will need to respond to these new customer demands by developing new business models to fund the on-board unit and connectivity costs, and to fend off commoditization and margin pressure.

In "Connected Vehicles: Service Providers at a Crossroads," Cisco IBSG provides a detailed perspective on market potential, trends, and business and technology implications of connected vehicles for service providers.

Begin the Journey to Global Automotive Transformation

Connecting vehicles and running transportation on networked information is:

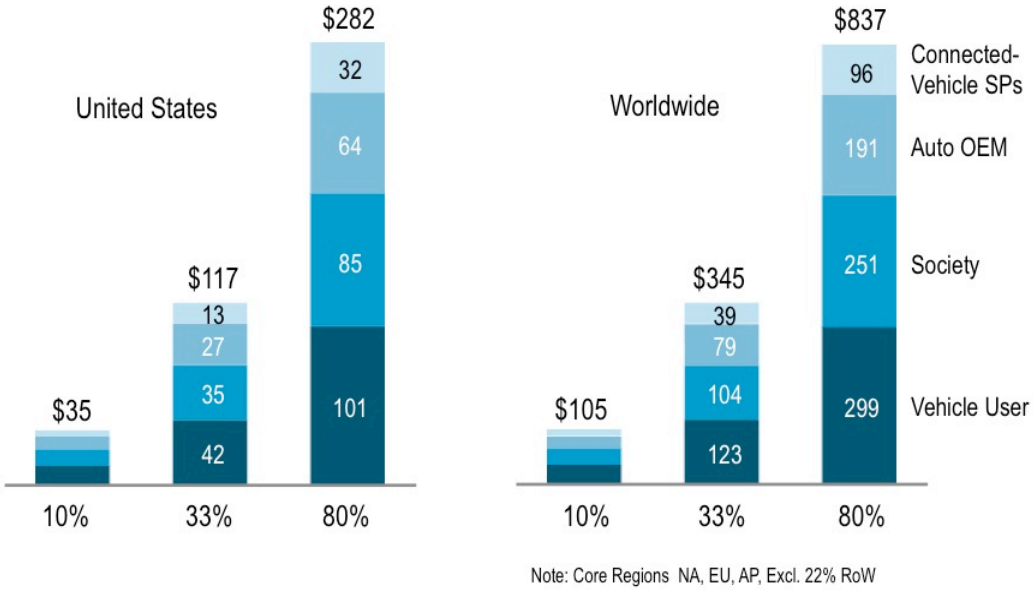
- A necessary investment in solving transportation gridlock that will inevitably be driven by global urbanization trends.
- A fertile ground to (1) transform existing business models in automotive, insurance, and service provider industries; (2) spawn many new business models; and (3) create an industry with up to 400,000 new jobs.
- A key competitive advantage for nations, with significant payback for the wealth and well-being of billions of people around the world.

Soon the growing pressure of urbanization is bound to push our automobile-centric personal transportation systems over the limit. The increased societal cost of congestion and crashes will suffocate economic prosperity in some of the most important business centers around the globe.

Cisco IBSG believes that to truly transform global personal transportation, we need to build personal and public transportation systems on a unified communications platform, bringing together an array of networked information. This approach has potential to go far beyond improving the traffic flow on our roads. The same platform could be used to offload data congestion from our communication networks, bringing us one step closer to realizing the promises of pervasive computing and location-based Internet services. In the process, this approach could give birth to a plethora of new business models along the connected transportation value chain.

Even if we succeed only in connecting part of our vehicle population, the value we could unlock for many stakeholders in the United States and across the world is tremendous. Connecting one-third of all vehicles has the potential to tap more than $100 billion of value in the United States and another $345 billion globally, as illustrated in Figure 7.

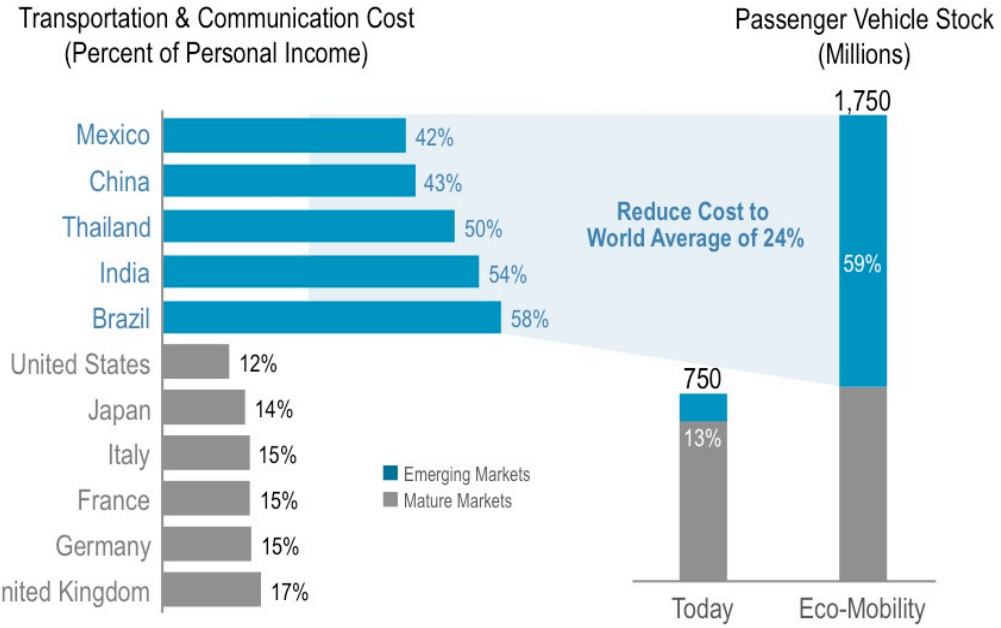
Figure 7. Benefits of Connecting All Vehicles per Year, by Penetration (in $ billions).



Source: Cisco IBSG, 2010

Reducing the inefficiencies and cost of mobility, along with enabling new business and pricing models, could make mobility more affordable for 1 billion people globally, as illustrated in Figure 8. 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 8. Transportation Cost, Income, and Vehicle Ownership: Emerging and Mature Markets.



Source: EIU Data, Cisco IBSG, 2010

This increase in demand would help the global automotive industry fill some of the overcapacity that has compressed profitability for the past decade.

Governments, automotive manufacturers, insurance companies, and service providers all have key roles to play in making this connected vehicle vision a reality:

- **Governments** hold the key to tapping $810 of the $1,400 in value per connected vehicle per year by reducing the cost of crashes and congestion. Innovative approaches like smart VMT, public-private partnerships for critical traffic infrastructure, and public co-financing of RSE infrastructure could help the industry capture another $590 per connected vehicle per year and spawn 400,000 new jobs.
- **Automotive manufacturers** that opt to invest in vehicle connectivity can add $210 gross margin in value-added service per vehicle per year by expanding the automotive value chain "from building cars to selling travel time well-spent."
- **Insurance companies and insurance telematics providers** that align their strategy with that of connected vehicle partners to address the entire insurance value chain can unlock more than $30 billion, or $380 per connected vehicle per year.
- **Service providers** have the potential to secure a $50 billion market segment by connecting nearly 300 million vehicles globally. This will require new business models and multi-radio technology that allow vehicles to stay connected at speed across multiple service provider networks.

In subsequent papers, IBSG will discuss how each of the above stakeholder groups can benefit from connecting vehicles:

- **Government: "**Connected Vehicles and Government: A Catalyst To Unlock the Societal Benefits of Transportation"
- **Automotive:** "Connected Vehicles: From Building Cars to Selling Travel Time Well-Spent"
- **Insurance:** "Connected Vehicle Insurance: The Business of Preventing Crashes"
- **Service Providers:** "Connected Vehicles: Service Providers at a Crossroads"

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Endnotes

1. IRF World Road Statistics Database, 2008; World Bank Global Road Safety Facility, 2010; Cisco IBSG, 2011. All currency figures in this paper are in U.S. dollars.
2. While the issues discussed in this paper are global in scope, many of the examples are specific to the United States, where Cisco IBSG has conducted in-depth research.
3. Victoria Transport Policy Institute, American Automobile Association, United States Department of Transportation, Automotive News Datacenter, 2010.
4. A Pigouvian tax is a special fee on goods and services whose prices do not reflect the true societal cost of their consumption. Arthur Pigou, 20th century English economist, developed this concept as a way to cover the social cost of a market activity that generates "negative externalities" that are not covered by the private cost of the activity.
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12. Source: Cisco IBSG, 2011, based on estimates for more than 50 potential connected vehicle profit pools after applying conservative adoption rates that average about 18 percent.
13. "'Talking' Cars May Someday Warn of Crashes and Save Lives," *The Washington Post,* January 27, 2011.
14. OctoTelematics, 2010; Cisco IBSG, 2011.
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19. "Closing America's Infrastructure Gap: The Role of Public-Private Partnerships," Deloitte, 2007.
20. Cisco IBSG estimate, based on data from U.S. DOT, iSupply, McKinsey & Company, 2010.

More Information

Cisco Internet Business Solutions Group (IBSG), the company's global consultancy, helps CXOs from the world's largest public and private organizations solve critical business challenges. By connecting strategy, process, and technology, Cisco IBSG industry experts enable customers to turn visionary ideas into value.

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