

the **hammersmith** group
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The internet of things: Vehicles as networked objects

the **hammersmith** group

new york: 203 rivington street, suite 3a
new york, ny 10002

massachusetts: 259 south main street
bradford, ma 01835

t 917 447 8800

f 978 372 2949

thehammersmithgroup.com

Route 93 into Boston was a slow-moving sea of red brake lights. The GPS updated the route in response to news feeds from the state police. Routine construction on the tunnel and an accident on Storrow Drive. The GPS re-routed him through the scenic side roads of Somerville. He would have missed the unmarked police car hiding behind the bridge if Trapster hadn't warned him of the speed trap. A mile down the road, he noticed another police cruiser in the median strip and uploaded its location to Trapster.

On the way over, he stopped to let other vehicles cut into traffic, earning several digital thumbs-up from other drivers — good 'carma' points. At a red light near Davis Square, a new restaurant caught his attention and he bookmarked it on Foursquare. Approaching Harvard Square, the GPS parking spotter indicated there were several spaces available on a side street just up the road. Before locking the car, he sync'd the GPS to his smart phone so he wouldn't forget the car's location.

Welcome to networked vehicles.

Geolocation and social media can transform vehicles into networked objects. Technologies such as GPS, mobile internet, and social media can enhance the experience for drivers and passengers, and can reduce the frustration, expenses, and risk associated with issues such as traffic jams, speed traps, collisions, drunk driving, and finding urban parking spaces.

As vehicles become networked objects, they can interact inter-murally and intramurally. Vehicles offer several subsets of T2T (thing-to-thing) communications: V2P (vehicle-to-person), V2V (vehicle-to-vehicle) and V2I (vehicle-to-infrastructure) communications. This ability to communicate supports the Web 3.0 hallmarks of semantic search and actionable information — data that can influence a decision at the moment when it is needed.

Networked vehicles and real-time data

Networked vehicles have the potential to produce significant amounts of real-time data. Jeff Jarvis, author of *What Would*

Google Do?, has observed that “where data is, Google is sure to follow.” If this data is thoughtfully collected and applied, it can benefit drivers, corporations, and entities in charge of infrastructure and municipal emergency services.

“Data that can be collected and analyzed will reveal unexpected relationships, such as how different factors affect traffic,” said Michael Nelson, former Director of Internet Technology and Strategy at IBM, former advisor to Al Gore, and current an adjunct professor at Georgetown's Communications, Culture, and Technology program. “For example, an analysis could reveal how temperature and humidity affect the decision to drive or take public transportation, and these insights can influence management decisions or public policy.”

Recording vehicle performance data also supports preventative maintenance. Vehicles could send owners text or email reminders regarding oil changes or tune-ups. Currently, most users don't maintain that data, but they go to service shops such as Jiffy Lube, which maintains user information updated at each visit. However, that data is in a proprietary database that is not accessible by drivers, and is not available in real time.

The ability to selectively record and export trip information also helps with keeping accurate and verified trip records for corporate reimbursement or for tax purposes.

V2V communications and collective driving behavior

A city's traffic pattern is composed of the collective behavior of thousands of individual vehicles, but a single stalled vehicle in the highway can affect hundreds of cars in the immediate vicinity.

Attorney Christopher Brecht of Anchorage, Alaska, observed that "Even though birds fly beak to tail, and fish swim in schools where visibility is limited, you never see a rear-end collision. However, drivers on a highway do not have a group mentality."

Networked vehicles could communicate real-time data about driving conditions 20, 50, or 100 feet ahead, signaling a possible emergency and recommending a sudden deceleration or lane change in order to avoid a multiple rear-end collision. "Increasing awareness of road conditions reduces reaction times," said Brecht. "It would require considerable refinement, but the basic premise is that you don't want to hit the goose in front of you."

A similar concept can be found in the Personalized Rapid Transit (PRT) system being built in the planned car-free city of Masdar, in the United Arab Emirates. Master planned by Foster + Partners, the city was designed to function without cars. Instead, Masdar has a monorail, a pedestrian level, and a PRT system of futuristic pods that look like smart cars without steering wheels. Passengers enter a destination, and a combination of an algorithm and magnetic markers embedded in the tracks automatically steers the pod to its destination. The PRTs are based on the automated inventory systems currently used in large warehouses. The first phase of the city is scheduled for completion in 2009.

The Hearst Tower in New York City employs next-generation elevators that use an algorithm to group passengers by destination, which reduces waiting time and number of stops. It may be possible to extend this insight into collective driving behavior, where certain roads or lanes may be more effective for express travel, while others are for local stops.

Social media and GPS enhance V2V and V2I communications

There is currently a limited vocabulary with which drivers can communicate with each other: brake and turn lights, flashing headlights to signal speed traps, and honking a horn.

"There are many opportunities for technology to improve vehicular communication," said Rob Faludi of New York University's Interactive Telecommunications Program. "Honking a horn can be easily misinterpreted. It can mean anything: you're in my way, there's danger ahead, or your bumper is about to fall off."

We primarily use GPS to provide real-time location and route information. Integrating GPS with real-time data about roadwork, accidents, or traffic jams would make it even more useful. An RSS feed from the local Department of Public Works or police department to your GPS, or user-generated reports of accidents could enable the system to propose alternate routes when there are traffic jams or construction along your current route.

Similarly, drivers often don't realize when they're entering a gridlock until after they've passed the only highway exit that would have let them take an alternate route. Networked cars would be able to sense the standstill ahead with enough lead time to propose taking the highway exit.

Similarly, services such as [Trapster](#) connect with GPS devices such as Garmins or TomToms and offer real time maps that indicate the location of speed traps. Trapster employs a wiki approach, allowing drivers to upload real-time information on new speed trap locations, as well. This service benefits drivers by reducing tickets and avoiding insurance premiums, and supports the police's goal of ensuring moderate speed on the roads.

Trapster represents one way that V2V communications and user-generated real-time content can create shared benefits and improve communication among drivers.

Gradient brake lights enhance visual V2V communications

Switching conventional brake lights with a vertical stack of lights could help drivers identify whether the vehicle in front of them is slowing down slightly or whether it's screeching to a halt.

Gradient brake lights offer an intuitive graphic representation of deceleration: out of five bulbs, one or two illuminated lights indicate a slight slowdown, while four or five signify a sudden drop in speed. When the brakes are fully depressed, the lights could also flash brightly or quickly, to further signal to drivers behind the vehicle that an abrupt stop is occurring.

To better communicate changes in the vehicle's speed, brake lights should be connected to both the braking system and to an accelerometer. This way, brake lights will also be activated when the accelerometer detects a passive drop in speed from the driver lifting their foot off the gas pedal, downshifting, or from coasting uphill.

Today's binary brake lights do little to avoid the rear-end collisions associated with sudden stops. Gradient brake lights improve the ability of cars to communicate, reducing auto damage, insurance and medical claims, traffic jams, and the municipal expenses of emergency response teams.

V2V communications and reputation systems

Jonathan Zittrain, co-founder of the Berkman Center for Internet & Society at Harvard University and author of *The future of the Internet and how to stop it* explores Lior Strahilevitz's concept of a reputation system for drivers based on the ones used by Cyworld, eBay, and Slashdot: "A technologically sophisticated version of the ["how's my driving"] scheme dispenses with the need to note a phone number and file a report. One could instead install transponders in every vehicle and ... If someone acts politely, say by allowing you to switch lanes, you can acknowledge it with a digital thumbs-up that is recorded on that driver's record. Cutting someone off in traffic earns a thumbs-down from the victim and other witnesses."

V2I communications and urban parking spaces

Equipping public parking spaces with sensors and transmitters could reduce the time that drivers spend circling the block looking for an open space. Embedded sensors could determine whether a space is occupied or not, and that data could be available on-demand via a car's GPS system, or through a heads-up display.

Social media enhances breathalyzer and ignition interlock functionality

There are over 1.4 million arrests for drunk driving in the United States, each year. In Sweden, regulators are expected to propose a deadline of 2012 for all cars to have ignition interlocks, which prevent the engine from starting if the driver is intoxicated. Volvo's Alcolock is built into the seat belt buckle, and Saab's Alcokey has the technology built into the key itself.

Adding logic to breathalyzers and connecting them to the internet means that they can provide much more valuable information than just blood alcohol content (BAC) levels and preventing a car from starting.

A networked breathalyzer can use GPS to determine acceptable BAC levels by state — especially critical if your route home crosses state lines, and you're borderline legal to drive in one state but not the other. Or perhaps it provides recommendations on how long to wait before you can drive safely, and sets an alarm on your phone when to take the breathalyzer again?

Or perhaps it facilitates calling a cab or other safe ride. "Connecting the breathalyzer to a social network like Facebook could provide a short list of nearby friends who might be willing to provide a ride," said Elizabeth Pigg, Vice President of Media Strategy at Edelman Digital.

This technology creates benefits for all parties. Keeping impaired drivers off the road reduces risks of accident and fatalities for other drivers. Municipalities benefit by reducing the expenses of

emergency personnel deployment, court time, and paperwork. And at-risk drivers benefit from avoiding the risks of arrest, fines, and insurance premiums.

Drunk driving occurs more frequently among the under-25 crowd, who are relatively new to both alcohol and driving. There is potential to reduce insurance premiums among the high-risk group by voluntarily installing one of these devices as a preventative measure.

Videocameras and dashcams

Videocameras embedded in cars could record valuable data, and could increase accountability among all parties on the road: the driver, other drivers, and police.

Video can function as a sort of citizen's watch for the roads.

Let's say you're driving home behind a car that's sliding across lanes and whose driver is exhibiting drunk or impaired behavior. You switch on the dashcam, creating a video record of the erratic driving and license plate number — footage that includes GPS coordinates and a time/date stamp for accuracy — and transmit the file to police electronically through your car's wifi. This would help police investigate immediately, and could also serve as court evidence.

Video could also function as part of a car's 'black box.'

In order not to use up massive amounts of memory, there could be a 30-60 second delay before deleting video footage. In case of a collision, sensors would instruct the cameras not to delete the prior minute of footage, along with the associated GPS and telemetry data. Or drivers could selectively record aggressive driving or road rage incidents that look like they could escalate, to provide a record of events that supports later testimony or insurance claims.

Rethinking planned obsolescence through modular vehicle components

Cars, like homes, represent one of the largest purchases for most consumers. People's needs in cars change every few years: single people may want a sporty car while young parents may want a safe and practical one. However, finances don't always permit new cars as needs change. Consumers shouldn't need to buy an entire new car just to access a few extras — it should be possible to upgrade vehicles incrementally, either by downloading third-party "apps" or by opening up physical upgrades to third-party manufacturers, in the way that we currently buy computers and houses.

If car manufacturers moved from a proprietary component model towards an open platform that allows consumers to integrate third-party products, it could significantly expand the possibilities for aftermarket products, upgrades, and co-branding arrangements.

Cars are as much about identity as utility; cars are extensions of how people want to see themselves, and how they'd like to be perceived. As a result, vehicles are ideal spaces for brands to coexist. What would Aeron-designed car seats look like? Is there a market for leather upholstery by Hermes? Or onboard entertainment systems from Apple, Boxee, or Hulu? There are also opportunities for celebrity-endorsed upgrade packages: there have been successful co-brands between Eddie Bauer and Ford Explorer, and between Martha Stewart and KB Homes.¹

Taking this a step further, 'opening the API' for vehicles to third-party developers would enable an unprecedented degree of personalization and functionality. App developers have used the iPhone's accelerometer and GPS in ways that the product designers may not have originally conceived — the accelerometer allows the iPhone to be used as a construction level, and can replicate the 'labyrinth' children's game. Most vehicles today have digital displays which lend themselves to potential upgrades and unexpected features of this sort.

¹ See also, *Cobranding's competitive advantage* (Urban Land, November 2006) http://thehammersmithgroup.com/about/images/ULI_December_Valhouli.pdf

Modular cars that allow incremental upgrades are inherently sustainable and environmentally sound. Engineering the underlying pieces to last longer, and allowing replacement of individual pieces rather than entire components diverts materials from the wastestream.

The ability to customize cars is an opportunity to re-examine what makes ownership attractive now that companies such as ZipCar are offering a viable alternative to owning or leasing cars. If ZipCar is differentiating itself based on utility, convenience, and reduced cost, then conventional car companies should explore customization and durability as ways to make car ownership more attractive relative to other options.

These features also present more compelling lifestyle marketing hooks than the conventional 30 second spots showing drivers speeding around curves in a manner which is likely to get them a four figure speeding ticket.

Constantine A. Valhouli is a principal with The Hammersmith Group, a strategy consulting firm.

About the author

Since 2004, Constantine A. Valhouli has served as principal of The Hammersmith Group, a strategy consulting firm focused on the intersection of real estate and technology. Hammersmith advises developers of sustainable and design-driven real estate projects, and consults to cities on reviving their historic downtowns. Hammersmith's work spans the planning and design phase to development and marketing of projects.

Constantine's work with Hammersmith includes some of the largest green developments in New England, one of the oldest towns in America, the largest private landholder in the only urban national park in the United States, and the governor of Massachusetts. His projects have received coverage in *Businessweek*, CNET, CNN/Money, NPR, and the *Wall Street Journal*, among others.

Constantine previously served as Director of Strategy for a sustainable real estate development company that did several high-profile adaptive reuse projects that incorporated some of the largest geothermal exchanges in New England. His career began in the Equity Research department of Morgan Stanley in New York City.

One of his white papers, "Valuing Green Buildings" is being taught at Stanford University and has been cited in Deloitte's *Sustainable Enterprise Report*. Valhouli has served as a panelist at industry conferences and the State Department, and has guest lectured at Columbia University, MIT, and New York University, among others.

Constantine has been quoted in articles for the Associated Press, CNBC, Developer, *Forbes*, *Los Angeles Times*, *Miami Herald*, *Newsweek*, *Silicon Alley Reporter*, *USA Today*, *US News & World Report*, and the *Washington Post*. His articles and op/eds have appeared in *Boston Business Journal*, *Boston Globe*, *Dwell*, *Fast Company*, *Fortune*, *Urban Land*, and the *Wall Street Journal*. He contributed to *Leadership Lessons from the Civil War* (Doubleday, 1999), written by Tom Wheeler (former head of the Cellular Telephone Industry Association and the Cable Television Industry Association) and Ron Nessen, former press secretary to President Gerald Ford.

Constantine has a deep interest in technology and media. He interned at the Washington Post during the launch of their online edition. He interned with early-stage fund Prospect Street Ventures, triple bottom line fund Dakai Ventures (social enterprise and technology), and Columbia's Digital Knowledge Ventures, the university's tech transfer division. Constantine's current research involves intelligent building systems, networked objects, and locative media.

He has directed or produced three award-winning documentary films that have received coverage in the *Glamour*, *New York Times*, *Oprah*, and *People*.

Constantine holds an MBA from Columbia Business School and an MA from Georgetown's Communication, Culture & Technology program. He is a Charles G. Koch Fellow with the Institute of Humane Studies, a think tank based in Washington, DC. He is a member of the Urban Land institute and the U.S. Green Building Council.