Urban Transportation Redesign

Thinking Long, Envisioning Solutions

The Urban Transportation Mess

Is America stuck in traffic?[1] We are more stuck than we realize. If it was our goal, fifty or sixty years ago, to create as much gridlock as possible, then as a nation we have done well. In so many large metro areas, success in the pursuit of gridlock is in our grasp.

Here, as elsewhere, we face a culture of thinking short. We are in the grip of design templates, replicated endlessly for six decades, whose consequences serve us poorly. We suffer, as a society, because we spend too much time on the road, and not enough time with our families or on our jobs. Lower income Americans suffer, particularly, because the indirect consequence of traffic congestion is a constricted supply of housing in urban America and a long-term upward creep in mortgages and rental payments. Those who can afford it the least get hurt the most. In a more clear-sighted America, we would have smarter transportation, healthier cities, and a knowledge economy of extraordinary vibrancy. In today's America, we have dumber transportation, weakened cities, and only a halting realization of our full economic potential. Here, as elsewhere, it is time to teach ourselves to read the balance sheet consequences, rethink our culture, and then adjust the design framework by which we grow urban transportation.

Thinking Long: Gridlock Math

Gridlock math is reasonably simple. The more we understand its lessons, the more leverage we'll have.

We start with an individual car, on the highway and driving in moderate traffic. The car itself is perhaps fifteen feet long. A motorist who understands defensive driving observes the two second rule: Always leave two seconds between your car and the car ahead. In smoothly flowing traffic, at thirty miles an hour the average driver requires a hundred lane-feet of total space for his car and for his two-second buffer. Traffic safety, in other words, means fifty cars per lane mile if everyone is driving at thirty miles per hour; if everyone is driving at sixty, the two second rule mandates two hundred lane feet per driver, or twenty-five cars per lane-mile. Violate the two-second rule, as so many of us do, and sooner or later a front-to-rear collision will bring everything to a dead halt. When we cheat, we pay.

If we think city traffic, we want to think of each car as a unit of demand, and we want to think of a hundred lane-feet of highway as the unit of capital the car demands.

Now take this simple lesson and try to visualize what happens as an urban area grows. And grows. And grows. Every square mile converted from farmland to subdivisions generates another thousand motorists, or two thousand, or even three thousand, depending on housing density.

At fifty motorists per lane mile, a thousand motorists translates into 20 lane miles of new demand. But the morning commute stretches out. If half a million cars are on the road at any one time, let's guess that a million and a half cars will take part in the morning commute overall,

counting from the beginning to the end. Instead of twenty lane miles of demand per thousand motorists, we need only a third that amount. Let's be cautious. For every thousand motorists added by new development, a growing urban area needs another six lane-miles of highway.

So what happens when total suburban population grows by a million? And the total commuter population grows by, say, half a million? By five hundred thousand, in other words, with each thousand requiring an additional six lane-miles of capacity?

Six per thousand, times five hundred thousand. The metro area requires an additional three thousand lane miles of highway capacity for each new million. Give or take.

Where are these new commuting lane miles needed? Will the strip mall highways built at the edge of the suburban ring take care of the need? A small part, perhaps, but commuters generally have to use existing highways to get themselves to existing job centers. Much of the commuting traffic has no choice – it has to use the existing highway network. Of the three thousand lane miles in new demand, let's guess that two thousand of those miles are to be traveled on the existing highway network. Where will those two thousand new lane-miles come from? On highways that are already full and cannot be widened?

Do you see where gridlock comes from?

Now think about the city bus. Imagine a city bus with thirty commuters. The bus is longer than a car, but the two second rule still applies. If a car needs one hundred lane feet, a city bus needs one hundred twenty. One hundred twenty lane feet, divided by thirty passengers. Four lane feet per passenger, for buses. One hundred lane feet per motorist, for cars. Relative to the number of lane-feet per passenger that a bus demands, cars gobble up lane-feet at a voracious rate. From a highway planning perspective, the capacity demands of automobiles are hellaciously high – a hundred lane-feet per motorist, versus four or five lane-feet per bus passenger. Per commuter served, cars demand an order of magnitude more highway capacity than buses.

And in this insight we discover the very essence of America's suburban transportation dilemma. In a cars-only transportation template, subdivision developers will generate units of lane-mile demand far faster than highway planners can ever hope to respond by creating new units of lane-mile supply. Consequence: gridlock. It is inevitable, and in a cars-only future, it will only get worse.

We have a cultural story that tells us otherwise, of course. And we have a transportation design process that serves our culture. America's suburban story promises the personal car as the ultimate symbol of personal freedom. It takes us where we want to go. It protects us from the rain. It carries our kids, our groceries, our purses and briefcases. It gives us speed; it advertises our success. For many of us, the suburban home is the further symbol of our success. Only losers ride buses. America's winners drive cars, vans, pickups, SUV's. Suburban planners cater to America's suburban vision. A single subdivision will sometimes occupy a full square mile. Only at its edge will there be a through highway, and the spacing of highways in the suburban grid will be as much as a mile apart. Our engines of template replication reproduce this pattern over and over again, with only modest variations.

Some economists think we should impose congestion fees, by which they really mean Decongestion Fees. Such a fee charges a well-heeled motorist for the privilege of driving on decongested streets. As should be obvious, decongestion fees have no bearing on the central

dilemma. Cars are space hogs – by their nature, they require the creation of far more highway capacity in crowded urban areas than anyone can afford to build.

We must teach ourselves to rethink urban transportation. The old culture points us in the wrong direction. The old promise doesn't deliver. The old template binds us to a future of endless gridlock. To think anew, it is essential that we begin with a creative and even futuristic design. Not till we imagine a truly different alternative will we see in full relief the opportunity ahead.

Transportation Redesign – Getting Started

It has been more than two hundred thirty years since America first declared itself an independent nation. On our eastern seaboard, many cities are now at least three hundred years old and counting. So let's give ourselves permission to look forward by a similar amount. A century from now, two centuries from now, what is our wish for America? Shall we bequeath to our descendants cities locked in perpetual gridlock because no one ever looked long, dreamed large, and redesigned for the common good? Or shall we do better, and become the author of cities whose transportation systems everyone admires?

Let us teach ourselves to dream ambitiously. America's transportation sector is central to this nation's infrastructure. It affects our well-being in a thousand ways; done badly, it is hard on human capital; done well, it is a credit to us all.

As we try to imagine our own future, let's draw a lesson or two from Singapore and from Curitiba.

Transportation in Singapore

The island nation of Singapore has evolved an unusual template for getting people around quickly and effectively.

Singapore is essentially an island nation, 270 square miles in size, with 4.6 million people - 17,000 per square mile, just a bit more crowded than the city of San Francisco and roughly six times larger in area. It is a prosperous first world city, by now, with an affluent middle class. Had Singapore allowed itself to become a city in which almost everyone commuted by car, its traffic congestion would be unbearable.

But Singapore is different, culturally, from America. In its Confucian value system, the role of the strong and wise leader is highly honored. This predisposes its people toward a more authoritarian model for transportation than other societies might accept. Car ownership is strictly limited. One must first buy an ownership license. These trade on the open market, and when times are good such a license can fetch its seller as much as $20 or $30 or $50 thousand. With license in hand, one is then permitted to buy and operate a car. It can cost quite a lot to buy the license and put a new car onto the streets of Singapore. Singapore therefore has many fewer cars on its streets than one would expect, given its prosperity and the size of its population.

Now imagine the public transit benefits. If traffic is light, traffic jams are rare. If traffic is light, buses can make good time on Singapore's streets and highways, even during the commuting hours. Bus service is frequent on each route. It takes little time to hail a bus, and little time to transfer from one line to another. Public transit commuters travel from Point A to Point B much

more swiftly in Singapore than would ever be possible in an American city of equal size.[2]

Would Americans ever agree to a Singapore-type solution? Not likely. But there is a lesson to be drawn. When bus service is frequent and unhindered by congestion, it works for everyone.

Transportation in Curitiba

The Brazilian city of Curitiba has been blessed by mayors of great creativity. As in Singapore, the city's buses move swiftly, not because cars are restricted in number, but because the city has created dedicated traffic lanes for the sole use of its buses. When buses approach, traffic lights turn green.[3] Bus stops have special loading platforms. Riders pay to board the platform. The bus pulls up to the loading platform, its doors open, its passengers board, its doors close, the bus is on its way.[4] Very simple, very fast. Excellent service isn't an accident; it is a performance standard, and design elements bend toward excellence. Curitiba's rapid transit approach to bus service created an astonishing increase in ridership; over a two decade period, total ridership rose by a factor of fifty.[5] How did Curitiba evolve such an effective template? Jaime Lerner, the Curitiba mayor whose genius did so much to put Curitiba on the map, was by training an architect and urban planner. Lerner lived and breathed smart design. The success of Curitiba's bus system testifies to Lerner's creativity.

Transportation Design Principles

Good design begins with sensible design standards. A healthy transportation system promotes regional prosperity. America's cities, towns, and rural areas all benefit. It also promotes individual opportunity. It provides all individuals with access to schools, jobs, recreation, stores, friends, everything. And it operates swiftly and effectively. People and goods move about with little delay.

A healthy transportation system depends, also, on an intelligent approach to land use. Put stores and homes far apart and people are forced to travel more than they should; put stores and homes closer together, and travel times get shorter.

When planners and developers create great distances between office and homes, and design street patterns that are hostile to pedestrians and buses, they introduce unnecessary inefficiencies into urban life.

Smart growth advocates have long urged us to embrace Mixed Use, Mixed Income, Mixed Mode thinking. Let's bring all our resources closer together, they suggest, in attractive clusters that shorten travel distances and make daily life easy rather than hard. Smart land use decisions go hand and hand with smart transportation decisions, just as foolish land use decisions accompany foolish transportation choices. The smarter we are at transportation design, the better for land use planning; the smarter we are at land use planning, the better it is for transportation design.

These insights are so often ignored. Today's template for suburban subdivisions reminds one of the gallon-sized cans of beans that a school cafeteria might buy. If the cook pours an entire gallon can of beans into a giant pot, should we call it a meal? If a developer pours a full square mile of identical homes into a subdivision, should we call it a livable neighborhood? Healthy land use choices shouldn't look like they came out of a gallon can; they should look instead like the work of a

master chef. Creative. Distinct. Delightfully seasoned. Rich in possibility.

When we build, we build for the ages, for better or for worse. Why be ugly when we can be beautiful? Why be boring when we can be clever? Why be off-putting when we can be warm and friendly? Land choices have a very long tail; we should never be careless or dull.

Imagining the Transit Design We Need

It is time for America to blow the whistle on yesterday's cars-only mold for suburban growth. But before we do, we require a sensible idea of what we would recommend as the better alternative. We don't want half-measures; we want excellence.

What I present here is a very particular scenario, one way of imagining excellence. As time goes on, the search for common good transportation will intensify and evolve. There will be other scenarios to evaluate, there will be comparisons to be drawn. I hope to set the bar high; with luck, ways will be found to raise it even further.

Let's imagine a future I call Concierge Transit.

Begin by picturing a luxury transit vehicle. Not a long black limousine, but still quite comfortable. I imagine a Starbucks® on wheels. Comfortable seating. Wifi service for laptops. Hot coffee, perhaps. And next to each seat, a place for the harried traveler to park an urban warrior rolling briefcase. Or park a shopping stroller, holding perhaps a bag of groceries.

The luxury transit vehicle might be a bus. Or it might be an automated guideway vehicle. We will meet both options in the Concierge Transit scenario.

Now picture a cell phone interface. When I board, I pass my cellphone over a cardreader. The reader recognizes my phone and bills me for the trip. My cellphone also tells me, at a glance, which bus to take, which route to choose, so that I can reach my destination quickly. I tell my cellphone where I'm going and it guides me every step of the way.

Several types of service come together in the Concierge Transit system.

The Subdivision Circulator

For millions of Americans, the typical morning commute begins on a winding suburban street, deep within a sprawling subdivision. Concierge Transit sends a vehicle to my door that's similar to a golf cart. The Subdivision Circulator arrives driverless, at two miles an hour, and it will take me to the nearby bus stop at the same speed if I just sit there. If I want, I can take the wheel and zip along at twenty. In a couple minutes I reach the nearby bus stop, just at the edge of the subdivision. I release the Subdivision Circulator and wait for the Concierge Neighborhood Bus.

The Concierge Neighborhood Bus

The Concierge Neighborhood Bus shows up quickly. In a properly designed system, it will have its own dedicated bus lane. The Neighborhood Bus is not a massive long distance coach; it is smaller and lower. It seats fifteen or twenty, a comfortable vehicle for commuters and shoppers alike.

For those stretches of the trip that border on residential neighborhoods, the bus line is parallel to the highway traffic. For stretches of the trip that parallel strip malls, the bus lane might

leave the highway and run through the strip mall parking lots. The point it to bring bus passengers much closer to the storefronts than today's highway-bound bus ever can. Covered bus stops and walkways to the stores make bus travel much easier for all-weather shoppers.

Routes for the Neighborhood Bus are usually rather short, no more than a mile or two in length. The Neighborhood Bus connects commuters and shoppers to Concierge Express stations, explained below. With two mile spacing between stations, bus routes are short, service is frequent, and no one waits long for their bus.

The Concierge Express

Bus travel, no matter how swift, has its limits. It makes good sense for people making short trips, but it has its drawbacks for longer trips. Most commuters have longer trips, and they want those trips to be as swift as possible. The solution is an automated guideway system.

Picture a light rail vehicle, much lighter than the standard subway car or streetcar. It travels on a guideway, twenty or thirty feet above the roadway. Its cars are automated, driverless, and often run singly, though they can be hooked together into small trains of two or three cars each. A single car carries a relatively small number of passengers, compared to a New York subway car. Twenty seated passengers might be a full load.

Most important of all, it travels directly to its destination, never stopping at intermediate stations. Loading and unloading is always done on spur guideways, never on the main guideway. This is a sharp departure from subway and light rail transit, whose trains and streetcars must stop at every single station. Intermediate stops are the bane of rail transit; with automated guideway transit, intermediate stops disappear altogether. On any car, or small train, all passengers are headed toward the same destination station. With no intermediate stops and no traffic lights, automated guideway transit is much faster than conventional subway or light rail transit. Concierge Express will often be faster than the passenger automobile.

Imagine a metro area of four hundred square miles, with stations spaced at two mile intervals. A city of this size would plan to have at least a hundred separate stations. The goal is to put every commuter within a mile or two of Concierge Express.

[Before I continue, readers should know that I inherited from my late father a tiny amount of stock in Taxi 2000, a company that offers a control system for running an automated guideway system. Taxi 2000's website features an attractive animation of its SkyWeb Express automated guideway scenario. The video is well worth watching. Unfortunately, SkyWeb's scenario assumes tiny cars that normally will carry but a single passenger. Such a design feature drastically cuts carrying capacity. A system filled with multi-seat, multi-passenger cars will serve many more passengers per lane mile than SkyWeb's model.[6]]

At the end of the evening commute on the Concierge Express, travelers are within a mile or two by bus of their final destinations. Some passengers will be able to walk home. And, from time to time, some will engage an hourly rental car.

Hourly Rental Car Service

Hourly rental car services already exist, and are especially valuable for those at the far end of a

subway line who need to drive a few more miles. A transit rider sometimes wants a car she can rent by the hour, especially if her client is still a few miles away from the end of the subway line. A subscription membership in an hourly rental car service is just the ticket. Hourly car rental companies – Zipcar®, for example – have cars waiting, parked just outside key subway stops. Go online, reserve your car, and when you arrive, use your Zipcard to drive off – that's the value proposition. Such services form a natural part of any concierge system.

Intercity Connectivity

The same logic can be applied to the creation of a twenty-first century inter-city rail or automated guideway network. Put the trackway on an elevated network and create self-powered train cars that cruise at 150 miles per hour or better. Use electricity generated from renewable sources to power the whole system. Move individual stations onto guideway spurs. Instead of running long trains that stop at every station, run single cars that run nonstop from origin to destination. An automated service can be driverless, but it might be well to give each car its own refreshment steward. Should there be an emergency, the refreshment steward handles whatever comes up.

Design the inter-city system so that it connects smoothly to the urban guideway networks on its path. Aim for frequent trips among all pair cities, and allow for on demand service as well. If a group of thirty or more wants to travel together, make a car available at a time of their choosing.

Design the inter-city system so that it can also carry freight. The train cars themselves must be models of aerodynamic efficiency, but with proper design, containerized freight becomes an option.

And design the metro area systems to handle freight as well, especially at night during off-peak service hours.

A single design vision that integrates inter-city travel and metro area travel implies a national policy commitment. Operating authorities may differ from one city to the next, but the design standards ought to be unified.

Anticipating the Bugs and Hazards

A number of possible problems might bedevil an automated guideway network. It is essential to anticipate them, in advance, and choose designs that are durable enough to succeed no matter what.

There is a remote risk of large scale disaster. Vast solar-bred electrical storms hit the Earth's atmosphere from time to time. The largest in memory occurred in 1859, and shorted out telegraph lines. A storm of similar magnitude today would play havoc with electronic systems everywhere, and it behooves us to create backup systems that can survive such a storm and bring us back into business shortly afterwards. This is a global issue, not simply an automated guideway transit issue, but we must be sure that an automated transit system has proper survivability should such a storm strike without warning.

A specialized military weapon, the Electro-Magnetic Pulse Bomb (EMP Bomb), poses a similar threat. A high atmosphere EMP Bomb can send out a pulse so powerful that all unshielded computers in its range would be electronically fried in an instant. Used against America as an act of

war, its consequences would devastate a sizable part of this nation. On the other hand, any nation capable of launching such a weapon against us faces the certainty of an even more devastating counterattack, so the odds of an EMP attack are not that high.

West coast cities face earthquake risk. San Francisco and Los Angeles sit astride the fault line that separates the North American and Pacific tectonic plates. The two plates are moving in opposite directions with a relative speed of several centimeters a year. The land above bears the stress for as long as it can, and then with a giant rip, the crust is torn apart. The crust atop the Pacific plate moves north; the crust atop the North American plate moves south, and everyone up top experiences the crustal ripping as a massive earthquake. Any elevated system – even an elevated interstate system – must be flexible and durable enough to hang together no matter how vigorously it gets shaken. Of course, everyone in an earthquake zone gets shaken, not stirred, those on level ground just as much as those riding on elevated highways and bridges.

The plain old power failure is one of the more common risks. What if the grid goes down? Will the trains still run? Emergency generating backup is as essential for a transit system as it is for a hospital. Backup computer capabilities must also be at the ready. For every computer system in use, at least two backup systems must be in reserve, ready at a moment's notice to take over if the main system falters.

Suppose something unexpected happens that halts all the traffic on one of the guideways. Will stranded passengers be able to reach solid ground? Each guideway will need a safety walkway/wheelway. Should a string of cars become stranded in an emergency, passengers will need a way out and a way down, both those on foot and those in wheelchairs.

Should an individual car have a breakdown, it can be towed out by the car ahead or pushed out by the car behind. All cars can be linked together in short trains, when necessary, so every car will be capable of rescuing either the car ahead or the car behind.

The most important global challenge is expandable capacity. The more smoothly the Concierge Express runs, the higher its ridership will grow. Let's assume as our capacity metric five lane-feet of guideway per passenger. Should 500,000 passengers be on board at one time, the guideway system will require a minimum of 500 miles of guideway.

There are two ways to grow capacity. The simple method hooks more cars together into a single train. By itself, this improves capacity considerably. The permanent method adds more lane-miles of guideway. A young system might have only two lanes of guideway running overhead; a mature system might add a third, a fourth, even a fifth lane alongside the first two. Additional rights of way for guideway growth need to be inked in, early on, so that capacity expansion will always be feasible.

System expansions are never easy, but an automated guideway system can be expanded with much less fuss than a subway system or even a light rail system. Aerial rights of way are not nearly as obtrusive as ground level rights of way, no matter who owns the land. A further advantage of an aerial system is that it can often be built above an existing highway, land that a city or suburb already owns.

Think Long. Design Well. Live Better.

The scenario proposed in this chapter suggests an effective means for counteracting gridlock

math. It shifts our cultural celebration of the car into a cultural celebration of world class urban transportation. It replaces incremental design with solution-oriented design. It proposes a set of design principles that can guide our transportation planning and spending for many decades to come.

From a job-seeker's point of view, it puts every job in reach of everyone seeking work. From an employer's point of view, it gives every employer in the metro area access to all the talent the metro region has to offer. It supports, as nothing else can, the rich networking so essential to America's knowledge economy future.

It has strong spillover benefits for housing affordability and human capital well-being. Though America is in a housing slump just now (2009), the long-run trend is toward supply shortages and rising prices. The upper middle class keeps up, but the middle class struggles, and lower income Americans suffer.

The simple answer to housing shortages is higher density. Double or triple or quadruple the amount of housing per acre in many areas around town, so that housing supply can keep up with demand, so that housing prices will rise more slowly.

In today's congested city, there are few who will welcome higher density. Density means congestion, congestion means delay, and existing neighbors fear their quality of life will decline.

In a Concierge Transit future, these fears shrink. As commuters flock to the speed and comfort of Concierge Express, streets decongest. Density loses its sting. Planners and developers have an easier time providing enough new housing to keep up with demand. With a more comfortable balance between supply and demand, it's easier for everyone to find affordable housing.

The benefits are clear. High quality public transit is in the public interest in so many different ways.

But the preparation period is lengthy. At every step along the way, each new development permit poses a threat. Land that should be set aside as right of way for a guideway system will be sacrificed in the name of expediency. Land that should be set aside for pedestrians, bicycles, and dedicated bus lanes will be sacrificed and squandered for other purposes. As a steel and concrete reality, Concierge Transit is many years away. As a design principle guiding land use decisions in all of urban America, though, it would be good if Concierge Transit were already a legally-endorsed transportation planning guideline.

We have reached a point where urban transportation is a national crisis, not just a local crisis, and it is best unraveled by a national decision to take this nation in a better and higher direction. It will be interesting to watch our learning curve. Are we capable of teaching ourselves to think long? Are we capable of teaching ourselves to insist on solution-oriented design? Or will America continue to be bamboozled by the romance of auto-centric transportation? Will gridlock math have as much free rein in the half century to come as it has had for the past half century?

If we want our cities and our metro areas to be places with real soul, we will want to teach ourselves to think long and design large. Our future is in our hands. It is ours to shape as long as we remember the code of the common good. Think long. Design well. Live better.

[1] This opening references the title of Anthony Downs, *Stuck in Traffic: Coping With Peak-Hour Congestion*. Brookings. 1992.

[2] Interview with David Summers, retired Foreign Service Officer, December 2005.

[3] See VirtualTourist.com, "Best Public Transportation System in the World," re Curitiba's bus system.

[4] Charles Landry. *The Art of City-Making*. Earthscan. 2007. P 379.

[5] Joseph Goodman, Melissa Laube, and Judith Schwenk. "Curitiba's Bus System is Model for Rapid Transit." Excerpted from a Federal Transportation Administration publication. http://www.urbanhabitat.org/node/344

[6] I owe thanks to my late father, Byron Johnson, and to the founder of Taxi 2000, J. Edward Anderson, for helping me understand the potential of point-to-point automated guideway transit.