COMMUTE

urt

autonomous public transport: urban rapid transit

vol. 1

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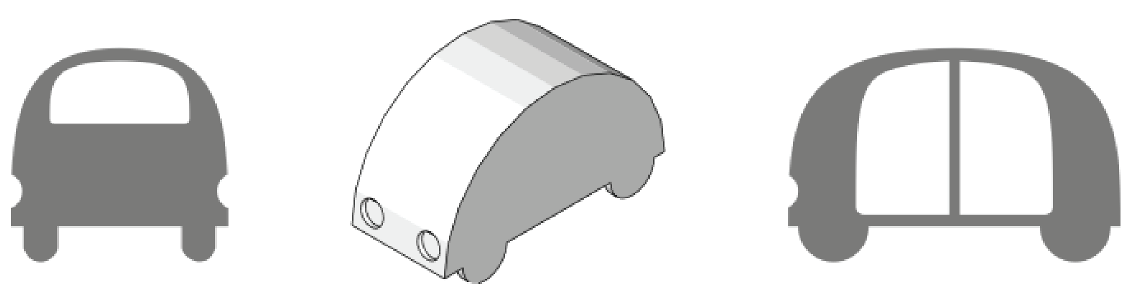

urban rapid transit

a public transportation mode for densely populated urban areas, featuring compact autonomous vehicles operating on an emergent network and integrating with existing infrastructure, reducing the burden of transport on the city and its citizens.

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abstract

This project lays the foundation for designing an emergent system of autonomous vehicles that will alleviate and potentially resolve the current and impending difficulty of urban transportation. This first phase frames the problem to determine a research direction and culminates in needs and specifications in which the system can be built within. In addition, this document includes a taster for the next phase in the design process; the vehicle design and user interface.

preface

COMMUTE first started out as a sophomore industrial design project at the Rhode Island School of Design, to conceive of a way to repurpose urban subway rail lines, by vanquishing the subway car and replacing them with personal pods that ride on one rail rather than two. Along the way, the technology available to build and design autonomous vehicles and emergently intelligent networks reached an economically viable juncture, resulting in a brand new window of opportunity for the basis for my degree project. However, this is a budding industry with every behemoth of the automobile industry pumping their stockpile of R&D funding into an incremental product, refusing to admit to the obsolescence of the modern automobile.

This project evolved as a way to undermine the hybrid car and our current notion of the alternative energy vehicle as an interim solution. As industrial designers, the bias to iteratively redesign the object rather than our behavior has led to a snowballing of an ecologically unsound culture of mass manufacturing, exemplified by the auto industry. The hope was to approach the automobile as a tabula rasa, with the intent of a solution to better the urban habitat, environmentally, economically and socially.

The document starts with numbers, by framing the current situation; how the automobile affects us and has shaped the way we live. Literary review, case studies, interviews and lab work provide an insight to the semiotics of our trivial commute, existing practices and their etymology, and the technical and political restraints of mass transit and mobility. A prior awareness of the capability and potential of autonomous vehicles, or driverless cars cooperating emergently, at least on the macro level, is assumed of the reader.

The research is initially presented through quotations and commentary from principal advocates in the field and the periphery, with additional inspiration drawn from historical context and nature. Accompanied by images and clippings, I hope to briefly compare and contrast the varying opinions, illustrate the breadth of the topic and stimulate reaction. The sources are plainly referenced and acknowledged at the bottom corner of the spread, with the layout conceived and implemented with the intensified creative license expected of a design student. The project then proceeds to the initial design concepts for a potential vehicle, and the framework for the user experience and interface, more of which will be showcased in the forthcoming publication. The next phase highlights the intersection of money and the commuter, and attempts to resolve the issue through the development of a seamless system of monetary exchange to facilitate the adoption of the autonomous vehicle in the public sector.

--Restore human legs as a means of travel. Pedestrians rely on food for fuel and need no special parking facilities.
- Lewis Mumford

As this was initially intended as an online document, a large amount of this project is dependent on dynamic media such as video and animation. Footnotes, references and external links are mostly live and hyperlinked to sources on the web. However, for readers with a preference for the tactility of pulp, this document is also printer-friendly in pdf format, with all the live content found at **www.jeromearul.com/commute**

A to B. People need to get to places. People need to get to places fast, and people need to get to places cheap.

The relationship between speed and cost is proportional. The faster you travel, the more expensive it is.

The key to making this cheaper is an economy of scale. You split the cost of travelling faster amongst more people, thus you have mass transit: buses, subways, trains, and planes.

The more often a person uses mass transit from A to B and back again, eventually stops being called travel; it's called a commute.

Traditionally, to make commuting faster, you segregate mass transit from personal transport, thus trains have tracks, and cars have roads, they don't intermingle nor interrupt the other's average speed. But building a separate infrastructure is expensive, which defies the frugality of mass transit.
So unlike roads, mass transit doesn't serve every street or city block, but specific clusters: neighborhoods, commercial districts, and pockets of above-average population density. This means fewer routes, which is cheaper to develop, but less comprehensive.

With a variance in distance travelled and demographic served, the modes of transit will evolve for their peak utility. Shorter inner city distances are covered by bus whereas subways cover longer across-town routes. Commuter rails link to the suburbs and high-speed rail connects the larger metropolitan statistical area.

There is also a direct correlation between commuting times and the value of land: the further away one lives from the the city center, the more expensive the commute, but the cheaper rent is. Cities are denser at their center. They initially started growing skywards to compound land value and space in that density, and vertical growth meant cities were compact and maneuverable. But with the advent of the automobile, they just as quickly started growing outwards and consuming more acreage. The automobile invented sprawl. It invented the suburb.

The complexities of the city cannot be concisely described nor understood in any one scientific field, but blame for congestion, pollution, sprawl, urban heat islands, even depression and obesity can be easily allocated to the ineptitude of the automobile.

And the automobile in turn will blame its operator: us.

Indeed human nature, error and judgment are to blame for most injury and delay, which is why the arrival of the autonomous, self-driving car has promised a mode for safer, cleaner, more efficient personal transportation.

But the self-indulgent culture of owning personal vehicles is not sustainable or very efficient. Cities are huge, and uniquely strive off sharing amenities and resources due to their condensed ecosystems. We need transit that can be shared too. Better yet, autonomous transit that can be shared.

The city is a “lattice of systems”, and if we can observe, analyze and diagnose this organism, we can efficiently troubleshoot our mobility within them, and design transport structures that integrate with our fading metropolises. The Baroque had the power to build entire cities based on principle from scratch, and while that luxury is a tad post-ideological, there are emerging global giants that build entire cities in months, and can attest to the need of a reformed auto industry. We can now decentralize our vehicles’ sentience and load, seamlessly integrating into the city, progressively learning along the way with a complex and emergent grace. And we can build these transportation networks, based on principle, from scratch.

ref:
Christopher
Alexander

We can make our cities more pedestrian friendly, whilst, and through making inner city transport more efficient. We can enhance fluidity amongst these healthier modes of transit; from using bicycles, to our feet, and shared public transit. By making our transportation modular and scalable, we complement bottom-up urban planning that embraces intrinsic growth, while removing unnecessary, costly infrastructure that supported a redundant era. Our vehicles can waltz in unison, preventing gridlock, congestion or pollution, all as they monitor their colleague’s data and safety. We can minimize the footprint of vehicles on the street, by literally making them smaller and more agile, opening up sidewalks and creating room for trees. With this we can tackle the impending population boom, the ensuing migration and depression, and the rise of the mass-manufactured city.

Most importantly, by designing vehicles that are simply social, fair and unobtrusive, we can expect communities to learn to trust their autonomous counterparts, and adopt them to drive their kids to school. Transit will be designed equitably with tiered pricing options and yet inclusive of the capability to comfortably and digitally personalize their travel experience. Urban Rapid Transit has the potential to enhance a city with remarkable, aggregated economic gain, with palpable incentives for any taxpayer or legislator. With vehicles that aren’t bound by heavy infrastructure, municipal boundary or political bias, we can amply serve every demographic creed, income group or citizen with special needs, ensuring they reach their destination, fast and cheap.

If anything, what I hope this project will foster are rudimentary thoughts of discarding our ingrained preconception of transportation, commuting and the automobile by redefining the paradigms of how we use transit.

the concrete cloverleaf

In the United States, the automobile is the travel mode for 88 percent of commuting and over 90 percent of all travel.

The typical US commuter in 2003 wasted about 47 hours, or two days of that year stuck sitting in their car, due to traffic congestion.
And it varies with city:

93 hours in Los Angeles
72 hours in San Francisco
69 hours in Washington DC
67 hours in Atlanta
63 hours in Houston

In addition to that, $5 billion worth of gasoline and diesel is wasted each year because of delays, slow travel, and idle engines running in traffic.

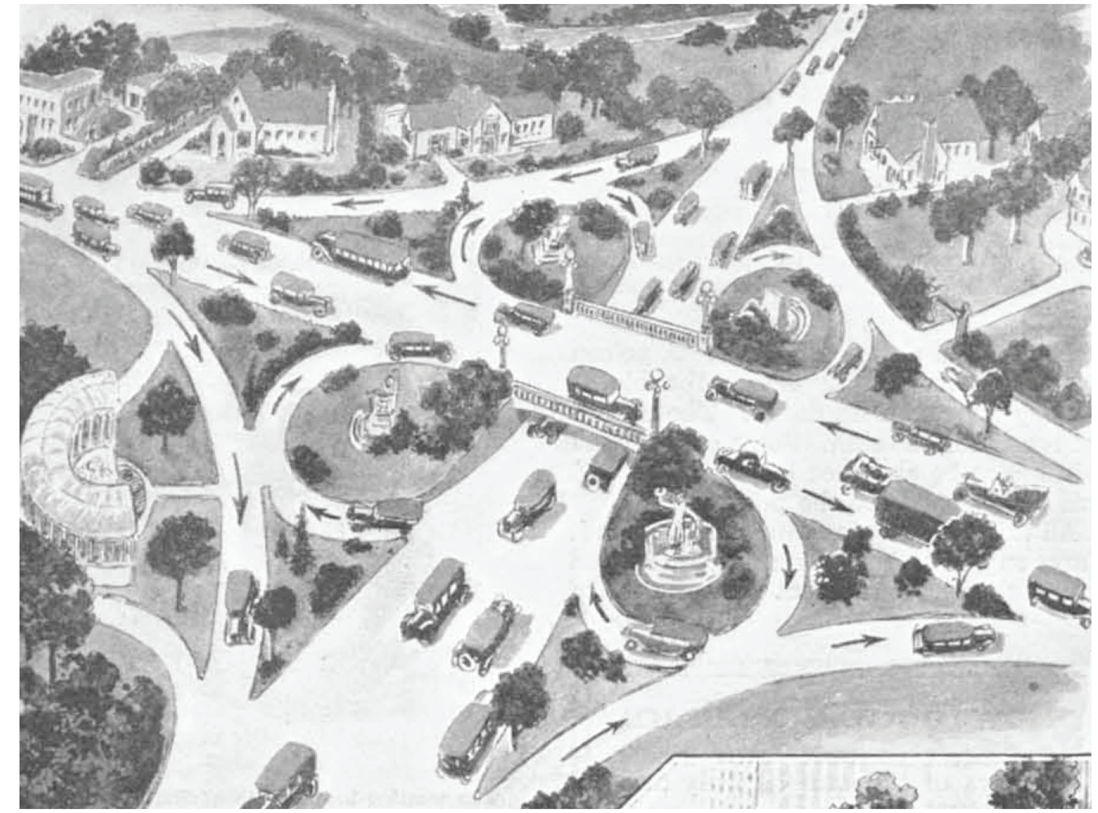
By adding the value of lost time to the amount of wasted fuel, the annual cost, economically, comes up to $63 billion per year. Comparatively, this is about five times the congestion cost experienced about twenty years prior in 1982.

However, even with the amount of time wasted sitting in an automobile, the typical commuter only uses their vehicle a little more that 2 hours a day, with the car latently parked at least 90% of the time.

--Every car in America has five parking spaces, so we're giving fifteen hundred square feet to a car. That's just crazy, I don't give fifteen hundred square feet to my children.
- Peder Norby

Considering the acreage lost to a car at rest, up to 90% of road surface on highways is wasted to the space in between cars, attesting to their inefficiency in movement, especially with us behind the wheel.

ref:
Arthur O'Sullivan
Sebastien Thrun



--Safe Highways.
Harvey W. Corbett,
Popular Science,
August 1925

--Our national flower is the concrete cloverleaf.
- Lewis Mumford

evolution
From self-starting to power-steering to self-driving

The first car was nothing but a carriage without horses. We still designed compartments to store the whips and the reins in the very first car to acclimate people to the idea that this is very similar to a horse and buggy.

--There's not too many products that you can identify that have had the same fundamental genetic makeup for a hundred and twenty years. - Lawrence Burns

--Why are we all packaging ourselves in multi-thousand pound boxes to go just a few blocks? - Marissa Mayer

ant highways + biomimicry

--Slime mold builds networks that have been shown to be optimally efficient in transporting the nutrients over the area in question. If placed in a maze, for instance, with a source of food outside the maze, the slime mold will discover the shortest path out. Despite its ability to solve an array of problems, the slime mold was designed by evolution to solve just one problem: how to build an optimal transport network (for its nutrients).

--By forming three lanes of traffic during hunting expeditions, army ants in Panama come close to achieving the maximum possible rate of traffic flow. Given that army ants are blind, and that a hunting party might consist of 200,000 ants marching in opposite directions, it is surprising that they are able to maintain such efficiency. The answer lies in the behavioral differences between ants with food and ants without. Ants returning from a successful hunt are less likely to deviate when bumped. Weighed down by their prize, they simply continue to march in a line, guided by the pheromone trail of the ants in front of them. Ants traveling away from the nest carry no food, and are more likely to get out of the way. The result is a middle lane of food-toting ants moving in one direction, and two outer lanes of unburdened ants moving in the opposite direction. Using a computer model, researchers from Princeton University and the University of Bristol learned that, as behavioral differences decrease, traffic efficiency goes down. If burdened and unburdened ants behaved in roughly the same way, the three-lane system would deteriorate.

ref:
Andrew Adamatzky
Iain Couzin

--The first car and last carriage Acceptera 1931

--You get where you want to go, when you want to go, with the least fuss and muss. That's what we need.

- Buzz Aldrin, describing hitching a ride on a whale shark whilst scuba diving.

modal segregation

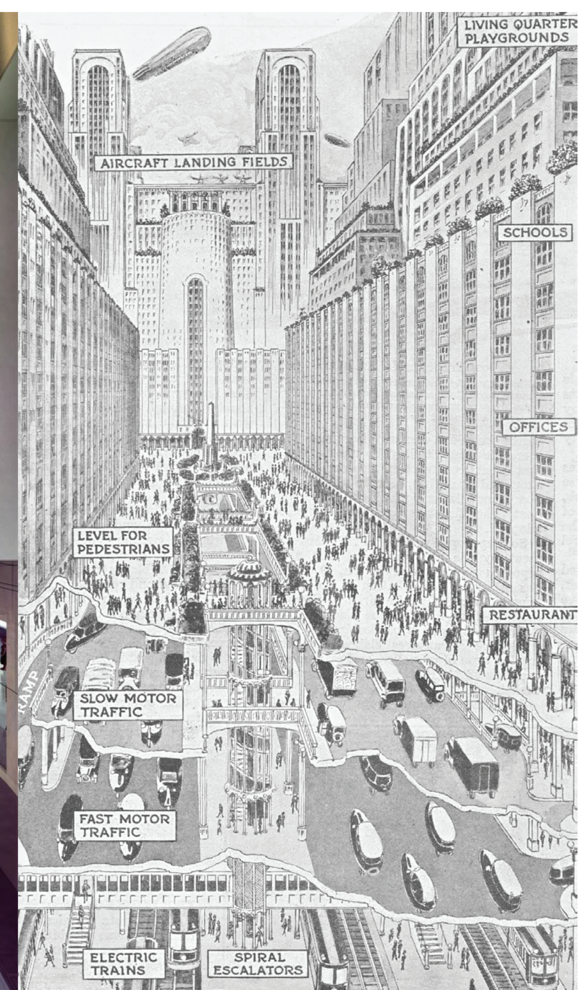
Louis Kahn, in one of his traffic movement studies of Philadelphia, "invoked the historical analogy of medieval walled cities. Just as walled cities were built for defense, Kahn envisioned the modern city center built to defend itself against the automobile."

--Everything that is rigid fails, everything that can evolve and adapt succeeds, so if we think of highways, you can't use it for any single other purpose.
- Robin Chase

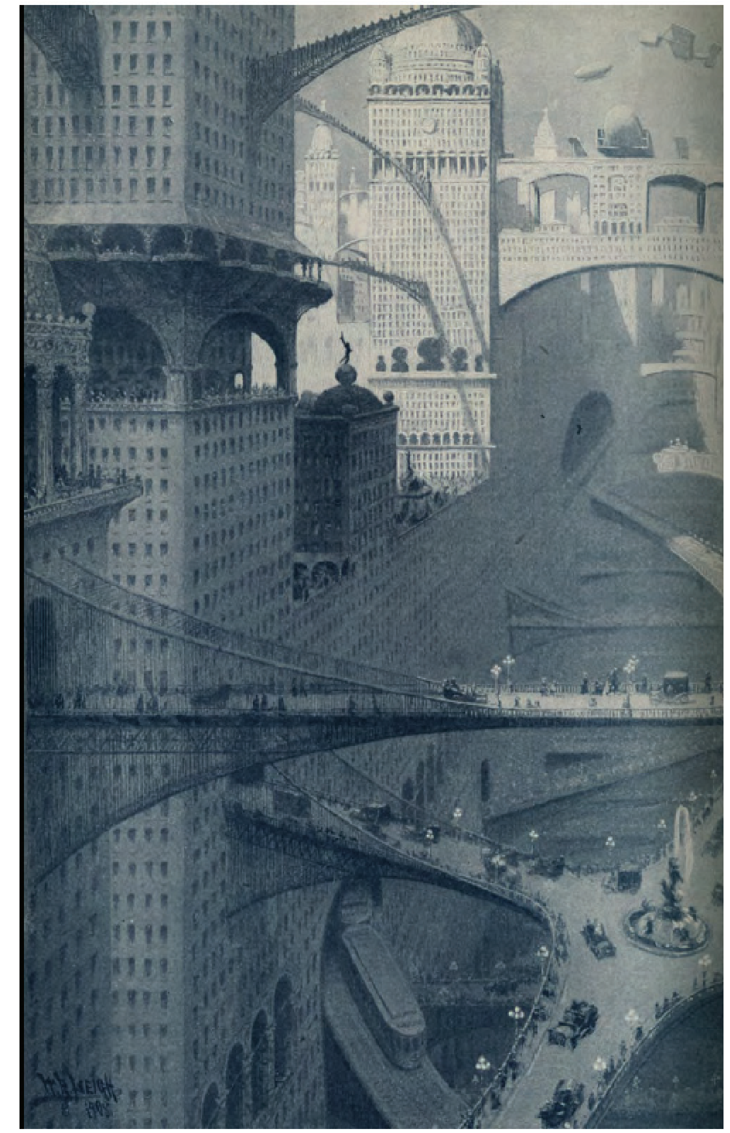
--Before 1956, the question was whether "to build a national system of highways, or a system of national highways."
- Tom Vanderbilt

--Masdar City,
Abu Dhabi, UAE

--City of 1950.
Harvey W. Corbett,
Popular Science,
August 1925



ref:
MoMa NY



--Future City,
William R. Leigh,
1908

--Adding highway lanes to deal with traffic congestion is like loosening your belt to cure obesity.
Lewis Mumford

Like the great modern metropolises, the URT city will be multilingual, but we won't be segregated into ethnic districts. Emergent robotic systems, that handle our transport, garbage and maintenance will need to speak a unique language to the city, and the city must be able to reply back. The landscape will be brimming with symbols and guides, registration codes for our robotic counterparts to interact with. Even physically, the way we design our streets and objects will reflect the docking mechanisms our cold friends interface with, and with which they nourish themselves with energy. Conversely, these interfaces will have to speak to us too.

As our cities grow, meet and overlap, they will have to speak the same language as we share our technology, and that requires a level of standardization that should be global.

--Society is the ultimate machine, so anything that happens, takes a total, global, cooperative effort" - Syd Mead

accepting science fiction

--[It is] an accident that the car was invented before the computer. - Anthony Levandowski

--Each of these developments generated a brief period of resistance, which faded quickly as the new system began to seem natural. We do not feel as if we have lost something essential. On the contrary, in the same way that it would now feel strange to be in an elevator run by a human operator, it's the absence of technology that begins to feel uncomfortable. Incrementally, more of the things that we think are innate to the driving experience—steering, braking, accelerating—will be out of our hands. - Tom Vanderbilt

--the fact that you're still driving is a bug, not a feature.

--This year, electronic stability control is standard on vehicles sold in the US for the same reason antilock brakes are standard in Europe: Its algorithms can perform better than humans in emergency maneuvering. - Tom Vanderbilt

--Attention Assist, Mercedes-Benz, 2008

--Hal 9000, 2001: A Space Odyssey, Stanley Kubrick, 1968

--Minority Report, Steven Spielberg, 2002

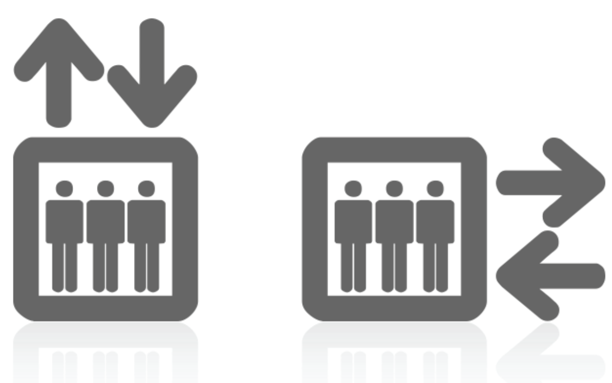
--Metropolis, Fritz Lang, 1927

sharing!

--Zipcar and PBSC Urban Solutions' Bixi bike

--Are we pilots or copilots? How far out of the loop can we be taken?
- Tom Vanderbilt

--you don't pay to get into an elevator; it's just assumed it's there to go from here to there.



--One of the things that struck me that, as we think about the future of transportation, that there is this dream and mania around alternative fuel cars. That doesn't solve congestion, doesn't solve the age of the population, doesn't solve the fact that it [costs] 20% of my income, it doesn't solve all of the other car related issues. - Robin Chase

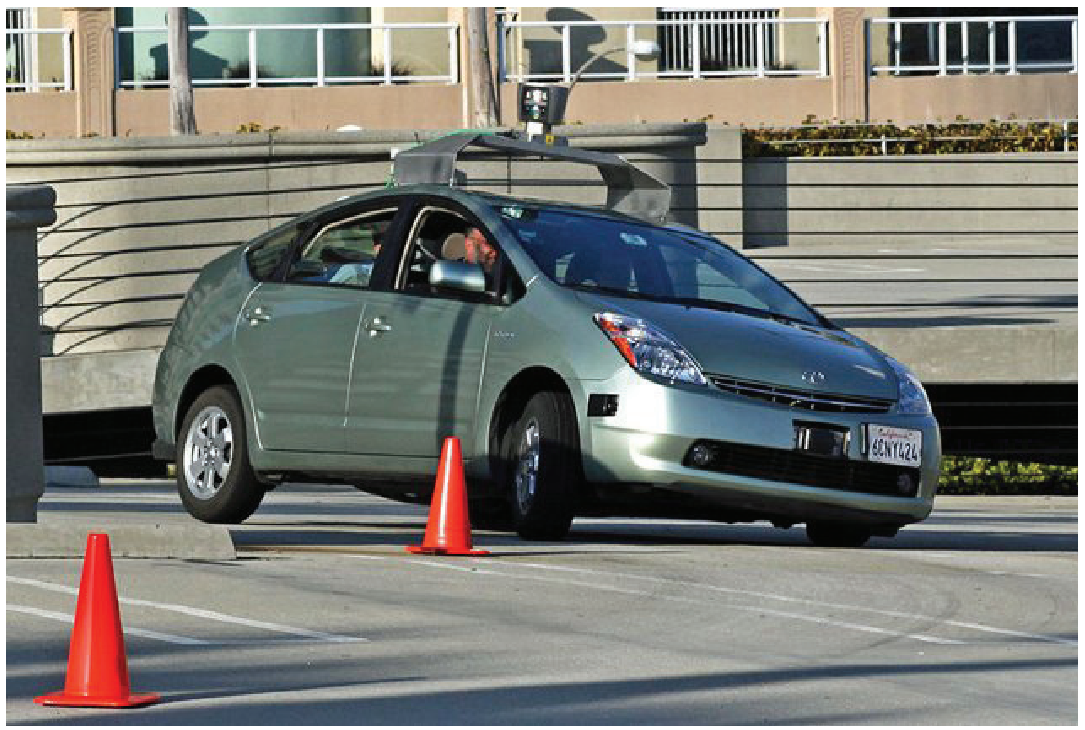
ref:
Syd Mead

--Boris Johnson and Arnold Schwarzenegger on Barclays Cycle Hire

Google

The auto industry’s biggest competitor when it comes to the driverless car is an outsider. Google’s self-driving car is leaps and bounds beyond the clutches of GM, Toyota and

Google’s driverless car

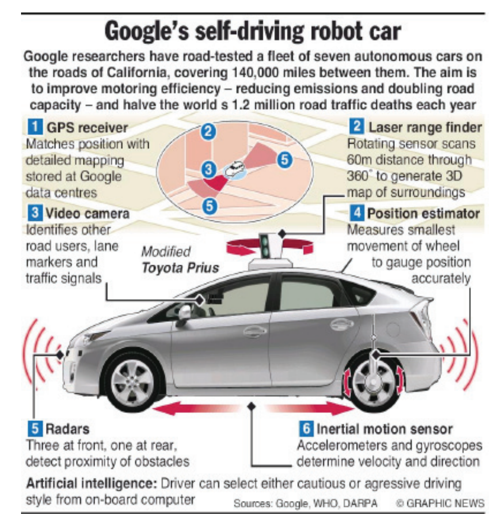


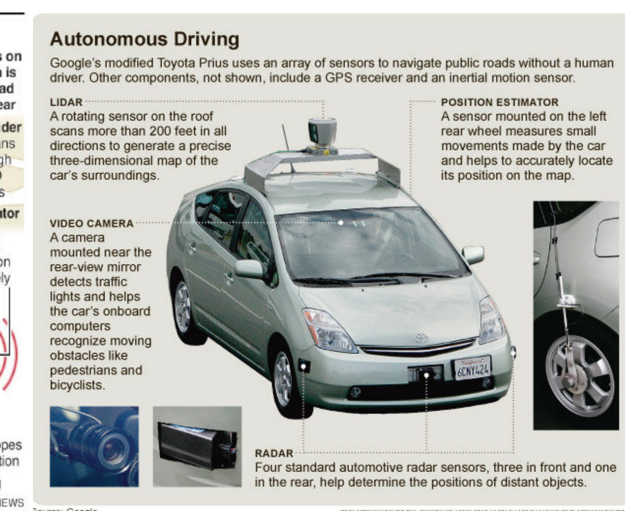
--Google uses LIDAR, radar, GPS, wheel encoders, gyros and accelerometers, to name a few, to accurately sense it’s surroundings

ref: Google

Daimler, with the technological prowess to limitlessly push R&D, free of the constraints of sustaining a market share or interfering with the lucrative end of their business.

Google also sources the techiest engineers in the sector; innovating, prototyping, playing, no holds barred. However, Google’s car is a research project, DARPA’s entry to a middle school science competition. Their car is the ultimate Prius, one that would take you anywhere, effortlessly on your part, but without any roof space for your surfboard. Google is designing the platform on which engineers can anally and meticulously iterate their locational accuracy to the fiftieth decimal place, but circumventing the larger systemic issue with the automobile. Each car is embedded with tens of thousands of dollars worth of computing and sensing power, capable of reading our environment better than we can, but simply adding tonnage to a car that each American is already consuming on bulk.





--Google’s hardware laden Prius.

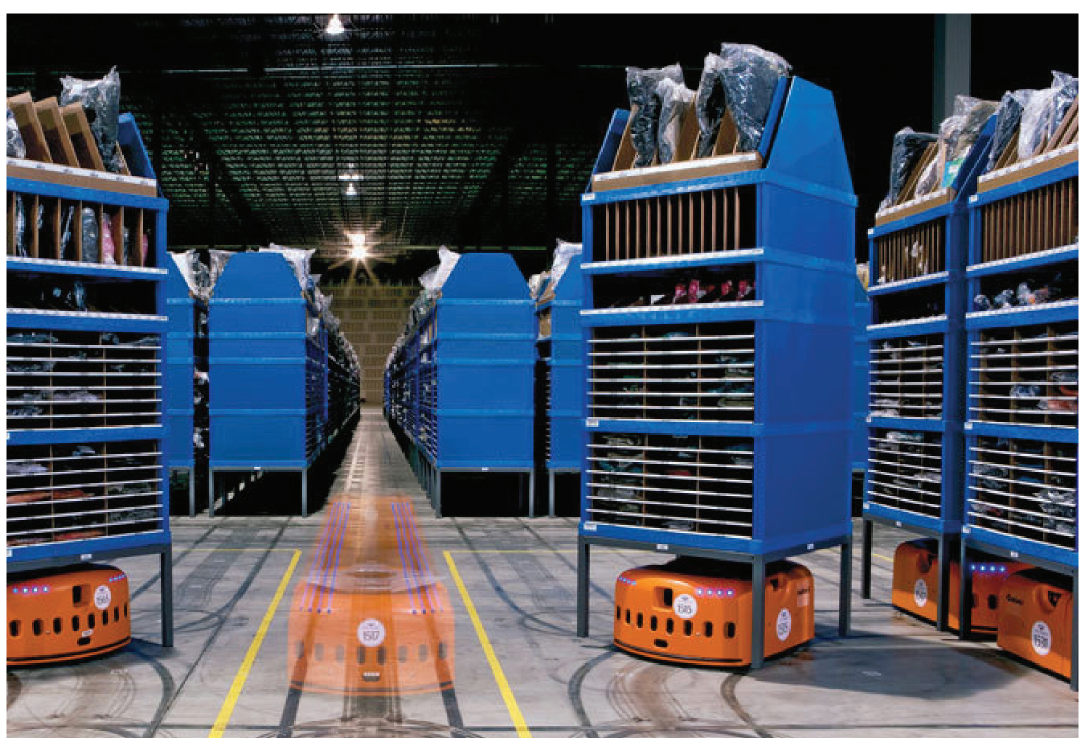
If we remove that clunk and share that infrastructure amongst more vehicles than one, their design could save through an economy of scale. By centralizing their hardware at the street level, and feeding their now unloaded vehicles with live data, we might have cleared some trunk space. Google’s golf carts at their Mountain View campus, unfortunately not showcased here, is however exemplary of this and the sort of easy-infrastructure vehicle that urban rapid transit would hope to embody.

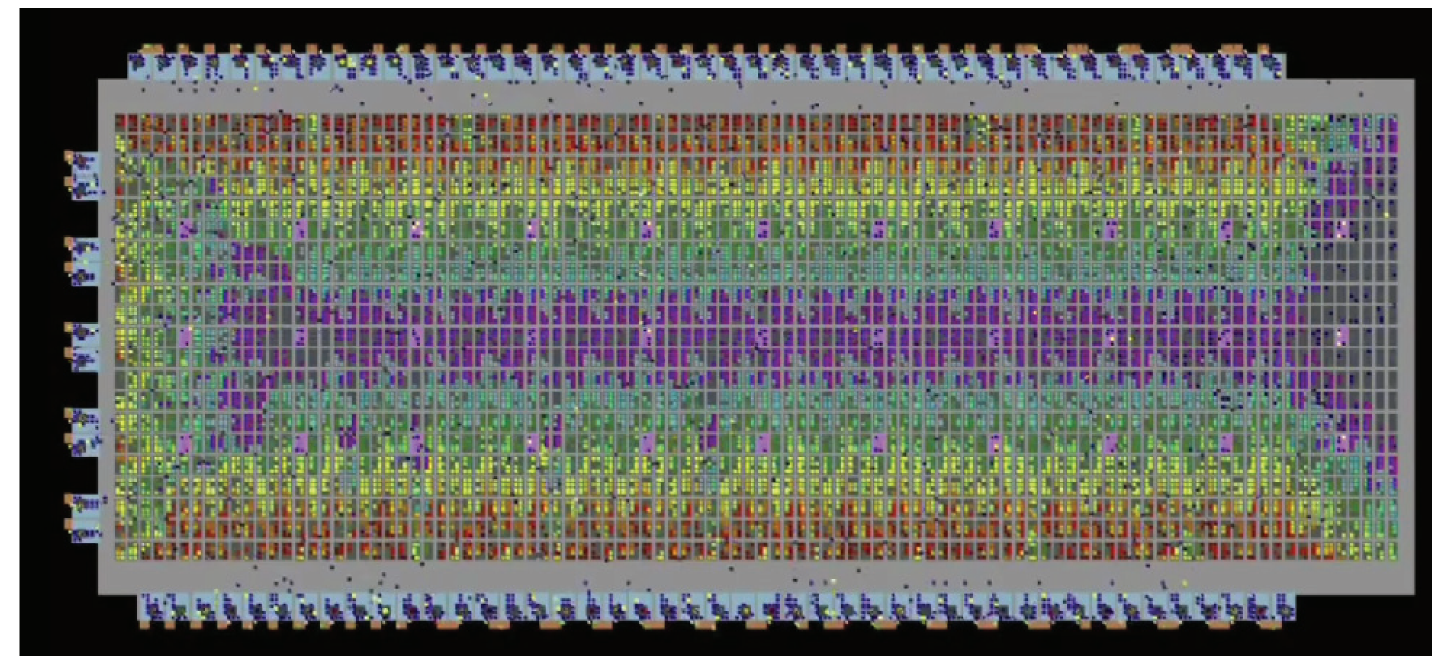
KIVA Systems

Unlike run-of-the-mill AGVs, usually glorified automated forklifts for factories, Kiva is a unique order fulfillment service. Kiva specializes in warehouse automation, utilizing a fleet of mobile robotic units capable of lifting a 1000-pound payload each. Hundreds of autonomous drive units are centrally directed and organized, with limited onboard processing power and minimal environment sensors, allowing for agile and nimble maneuverability in tight spaces. The units are fully aware of the locations and actions of their colleagues, and navigate along passive magnetic guidelines on the warehouse floor.

Kiva's logistics robots

--the drive units emergently communicate to fulfill orders and tasks on a minimal infrastructure





--kiva's warehouse optimization

(view online)

The control software optimizes handling and storage through progressive iteration, rearranging and adapting to a live feed of demand, with the modularity and flexibility of the units allowing for clients to scale their operation effortlessly.

Their ability to utilize a simple repeatable component, operate on an iota of physical infrastructure, and continuously optimize function and efficiency, would be ideal for the potential application and development of an emergent transportation system. A seat and an IPad to navigate would be the only remaining addition needed.

ref:
Kiva Systems
Mick Mountz
TED

Ultra's Personal Rapid Transit Pod

--The PRT also uses LIDAR, like Google's car, which seems overkill with the presence of a guideway.

ref: Ultra Global PRT

Ultra Global PRT is a British transport solutions company. Their personal rapid transit system for London's Heathrow Airport, a system that ferries 900 passengers daily from their business car park to Terminal 5, is currently their only active operation. They are also currently in the works to implement their PRT in Amritsar, India, the first urban application of a personal rapid transit system. Ultra's PRTs are isolated to only travel on specific elevated guideways, maximizing the necessity of infrastructure, increasing the physical footprint on an urban area, and making it costly and inflexible to scale up. However, Ultra has designed a comprehensive product, a vehicle that ergonomically fits 4 passengers comfortably and tries to embody a simple travel experience.

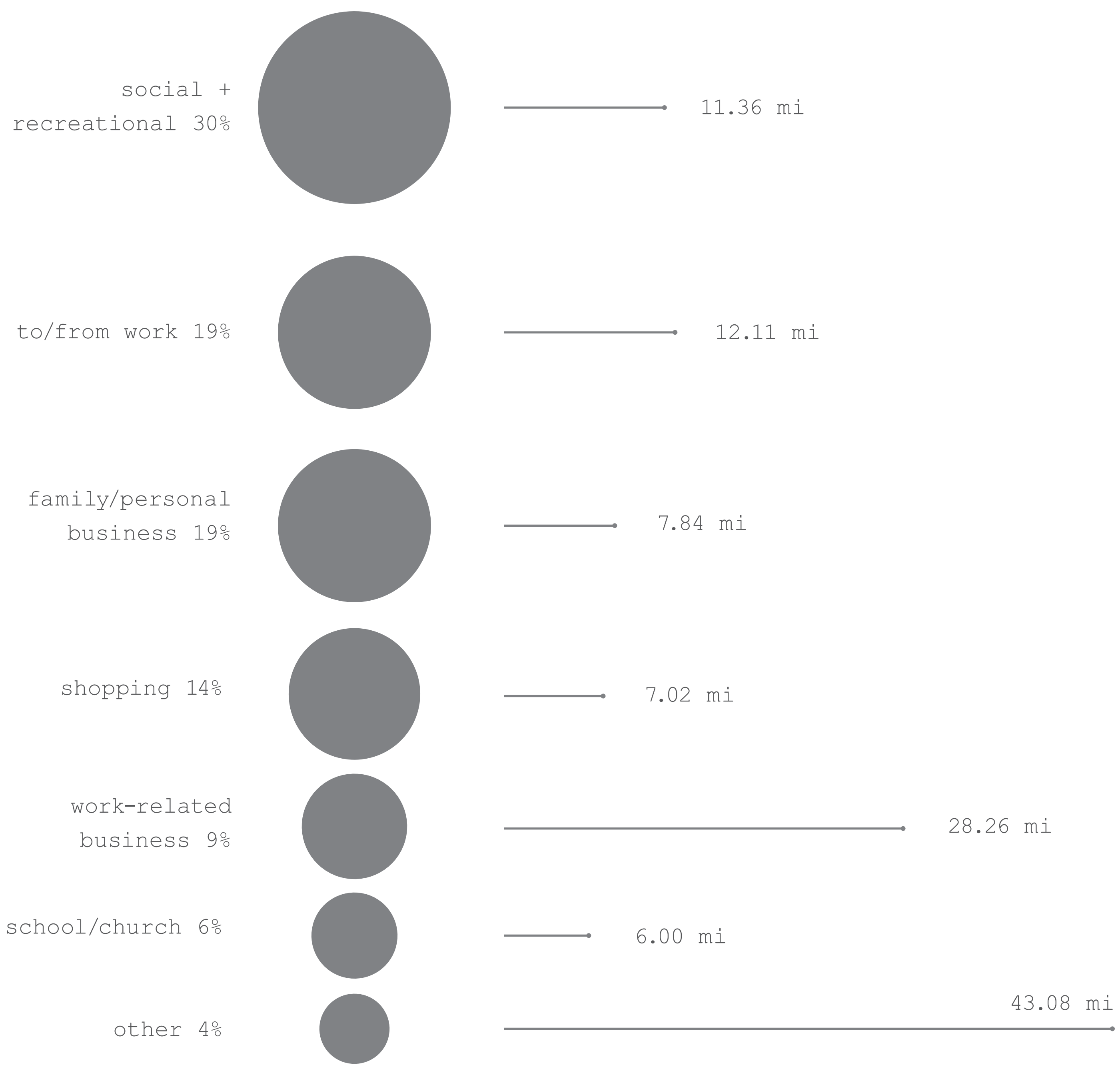
symbiosis of three systems

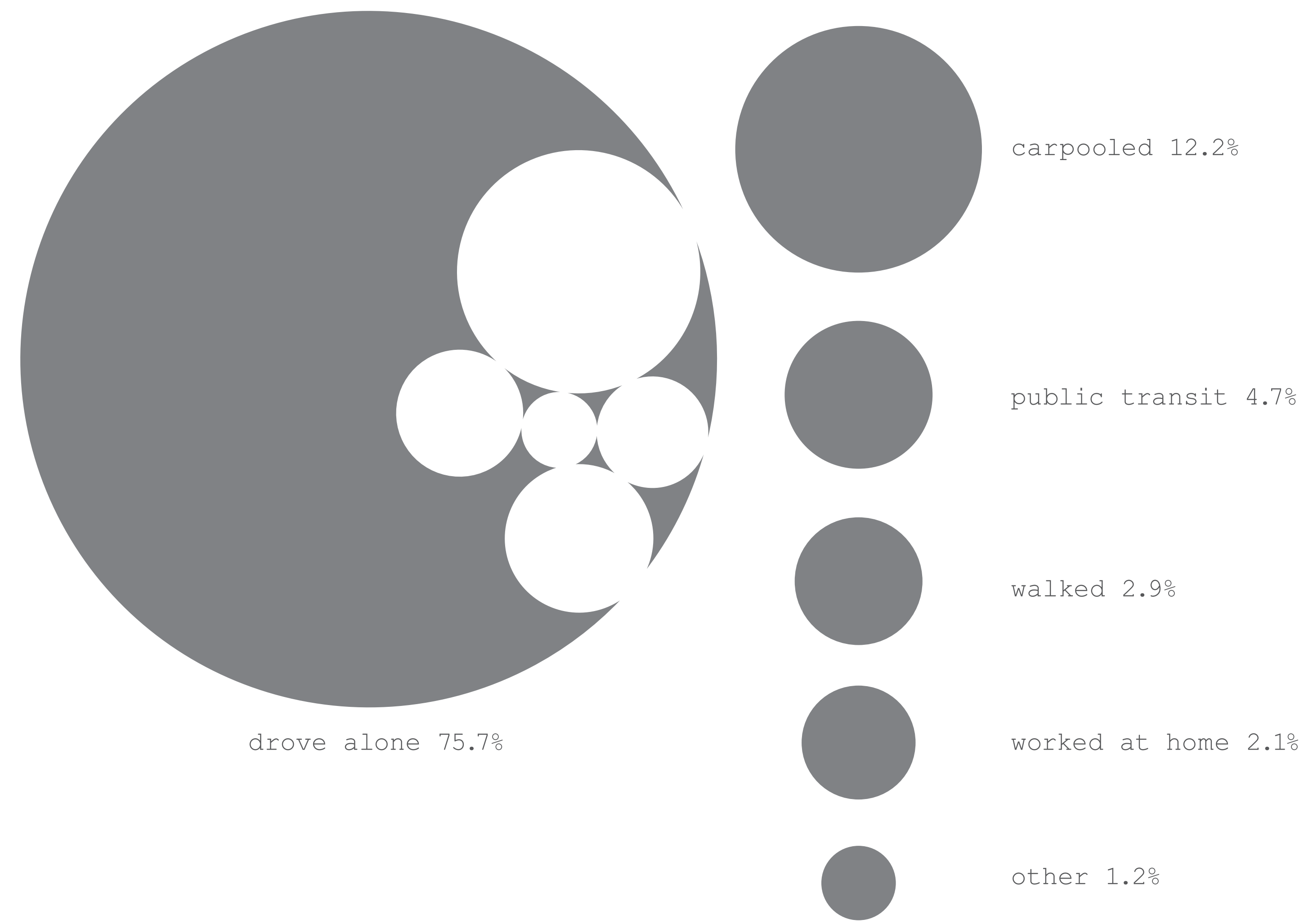
Ideally, Urban Rapid Transit should adopt a symbiosis of the three systems: Kiva exemplifies a networked grid of units that can be systemically optimized, and Ultra's pods already have all the functionality and vehicle design except secluded to a track and bound to a linear route. Add Google's car to the mix, and we have the ability to centralize our environment sensing capability both on the vehicles and on the street.

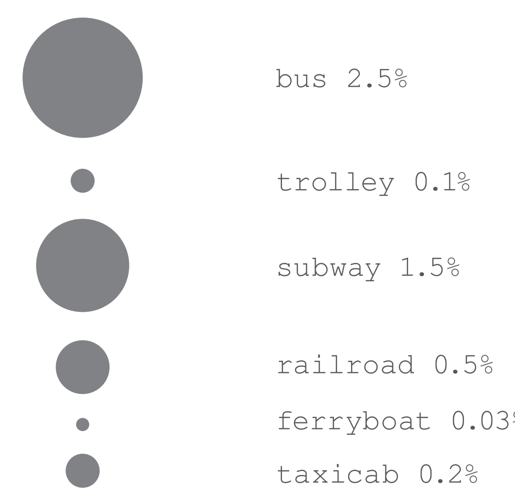
modal choice

below: for purpose of travel, 47% of all travel tends to be for business or work, with the average distance for that type of commute to be under 10 miles.

(diagrams are of relative scale)







this page: when it comes to mode of choice, 75.7% of commuters prefer to drive alone. Of the 4.7% public transit users (left); buses, subways, then railroads tend to be predominantly used.

data ref: Arthur O’Sullivan

mono-modal

mainline versus integrated systems

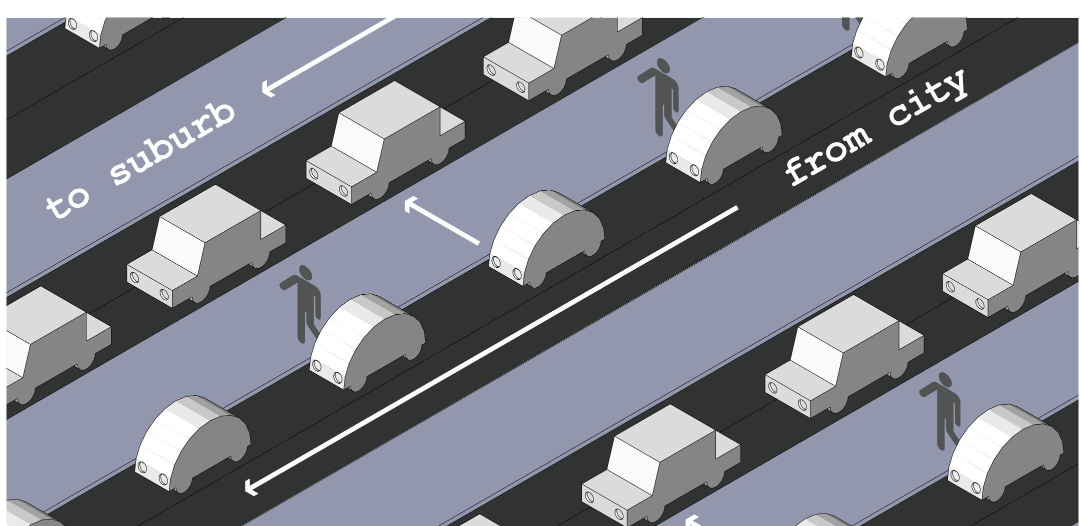
Public transport can be grouped into two systems, mainline and integrated:

mainline: eg. A rail system. Relies on other modes to distribute and feed riders from their cars, buses and neighborhoods.

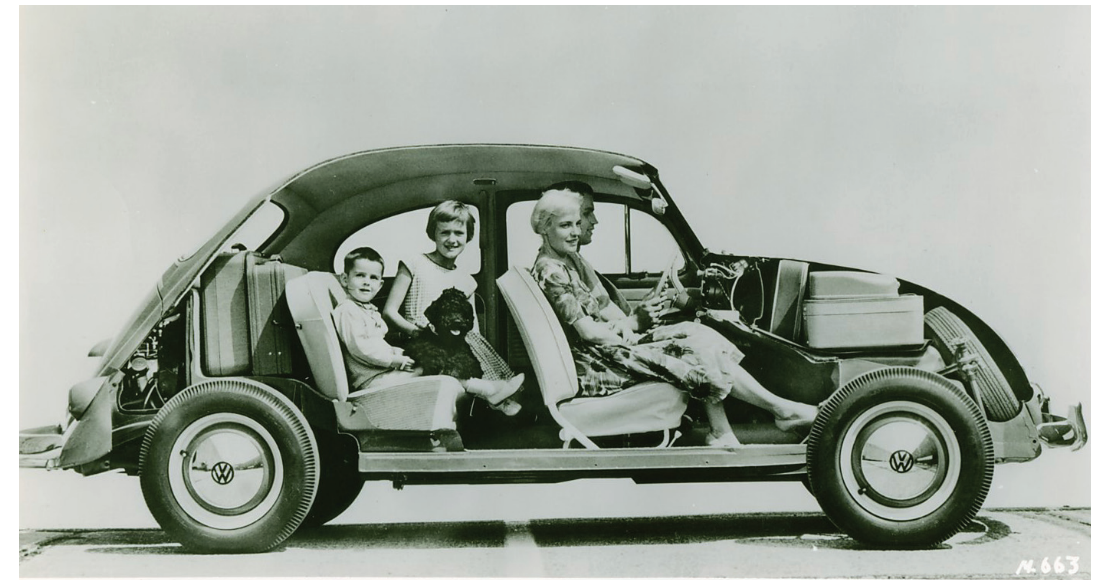
integrated: eg. A bus system. Keeps riders on the same vehicle for the entire trip.

The two systems can be part of a whole, especially in the case of urt, where it acts as an integrated when its operated alone in a closed loop system, yet remains mainline when fed off a perimeter of personal vehicles.

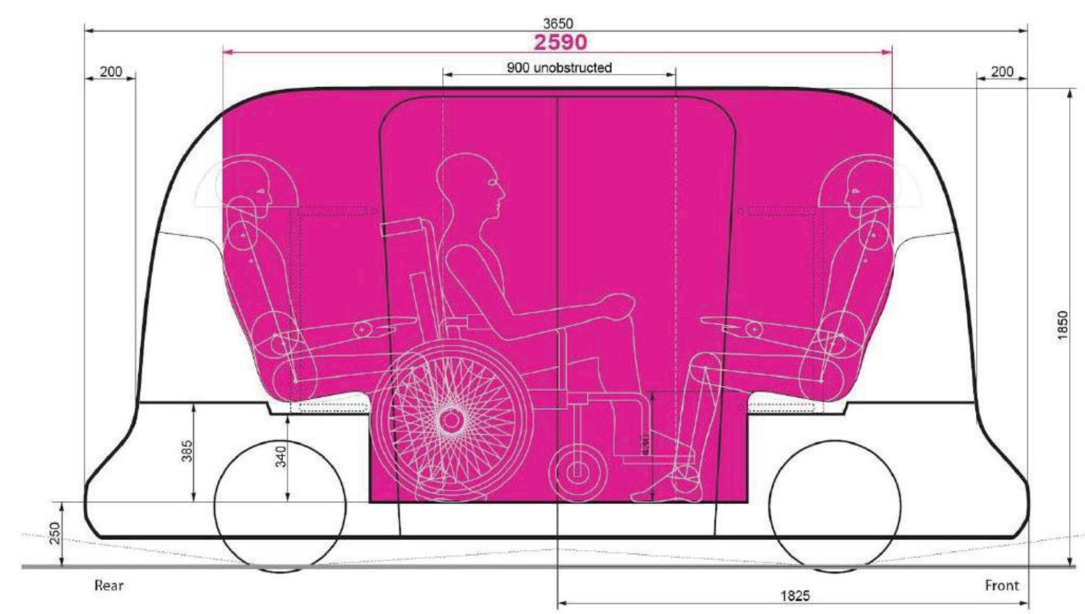
--transfer bay: from urt to personal autonomous vehicle



ref: Arthur O’Sullivan



--the people’s car, beetle, Volkswagen



--ergonomics, UltraPRT

--I will build a car for the great multitude.

- Henry Ford

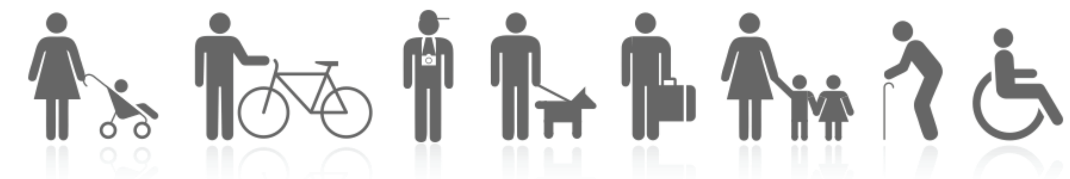
A mono-modal form of transit must plan and be designed for the variety of urban demographics it would encounter, and yet be modular and malleable enough to serve those groups exclusively as well as comprehensively.

client + user needs

The cost of urban transportation can be divided into three parts:

capital cost: the cost of laying rails and buying the transit vehicles.
operating cost: the cost of labor, (fuel), and maintenance of vehicles, roads and rails.
time cost: the disutility (opportunity cost) of travel time

clients are more wary of capital and operation, whereas time is more crucial to the user and commuter.



--there is a clear disctinction between a client and user of a urt system

clients

municipal entities that plan or fund urban redevelopment

contracted multi-national corporations that develop urban infrastructure

large corporations or institutions with a large enough campus

users: eg.

heavy: commuters

casual users: shoppers

non-local users: tourists

special needs: physically handicapped

client needs

capital costs
operating costs
time costs
reliability
manageability
scalable
security
opportunities + externalities

user needs

efficient + fast
reliability
cheap
pricing + service options
clean
easy to use
safe + secure
expandable

scale + implementation implementation of urt depend on the scale or acreage of the closed loop system and the realistic time frame, relative to now.

- urt concepts at the campus scale can be implemented at the present, similar to UltraPRT, other PRT concepts, and Google's golf carts.

- urt at the city scale can only be realized in the near future, as financial feasibility of the technology + infrastructure development requires further iterations.

campus scale applications

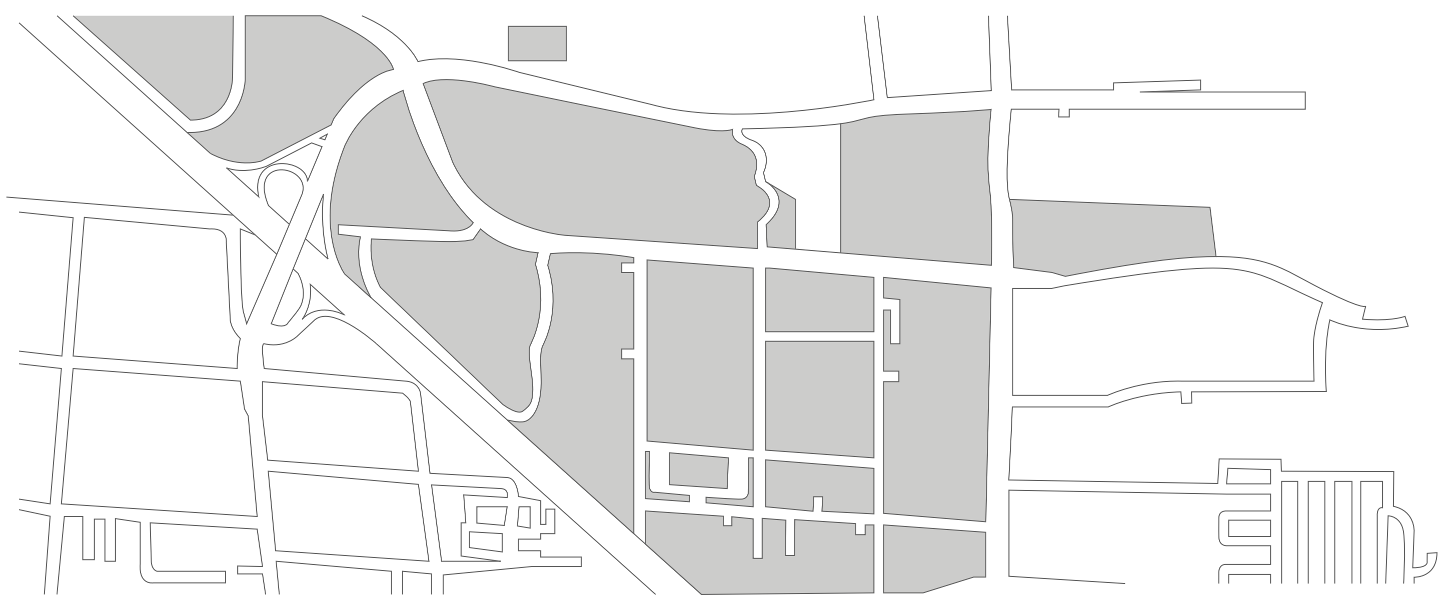
airports + hubs

corporate / university campuses

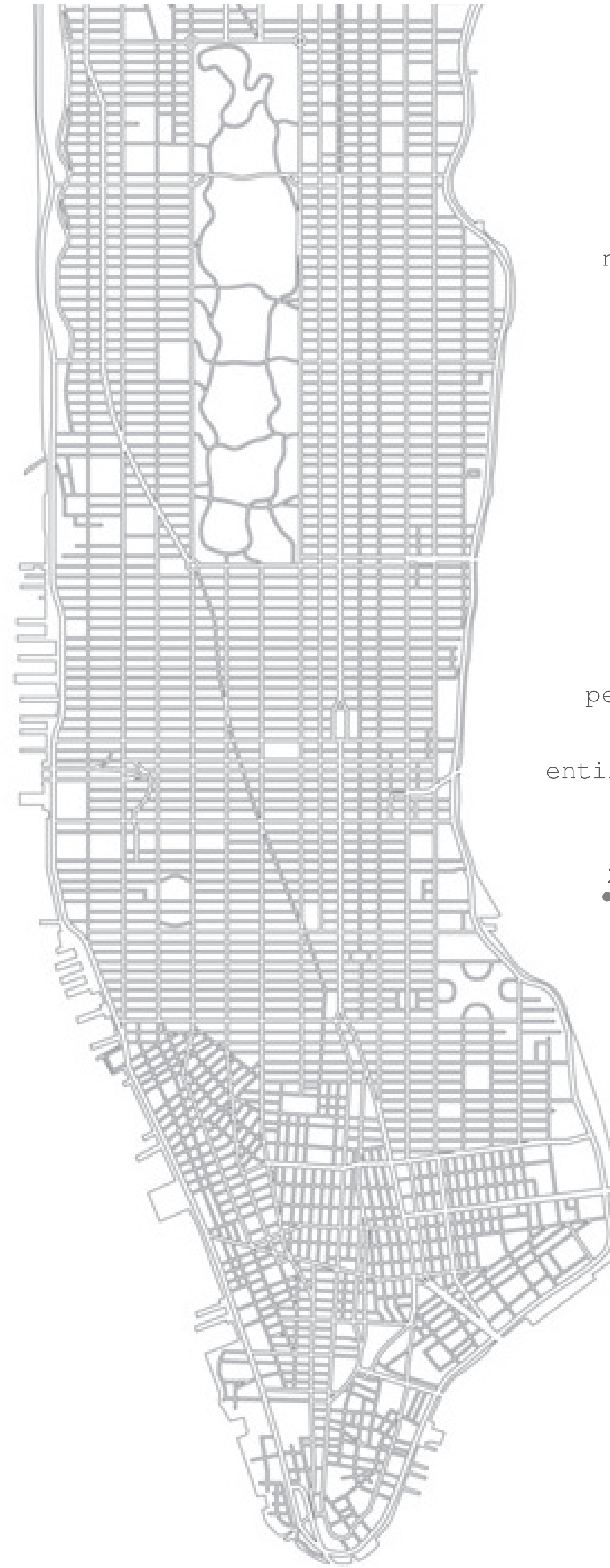
industrial / military complexes

present - near future

1000ft



Googleplex,
Google Campus



near future - onwards

city scale applications

downtowns

pedestrian urban areas

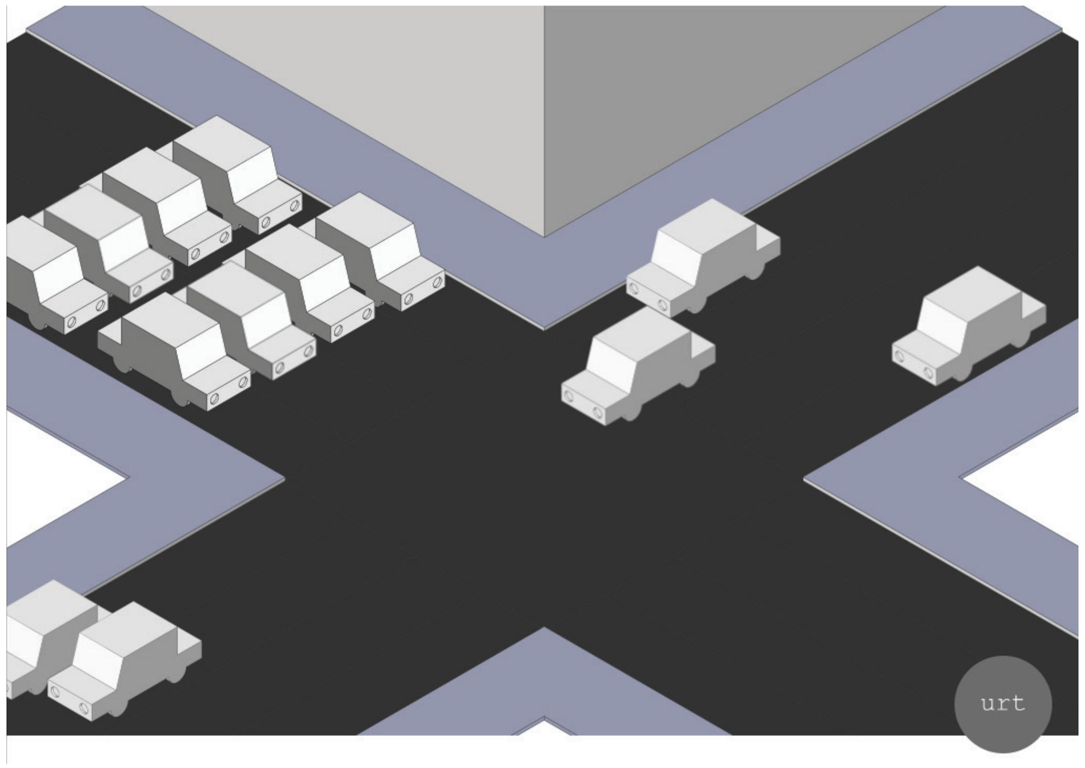
entire cities | old + new

2 mi

Manhattan,
NYC

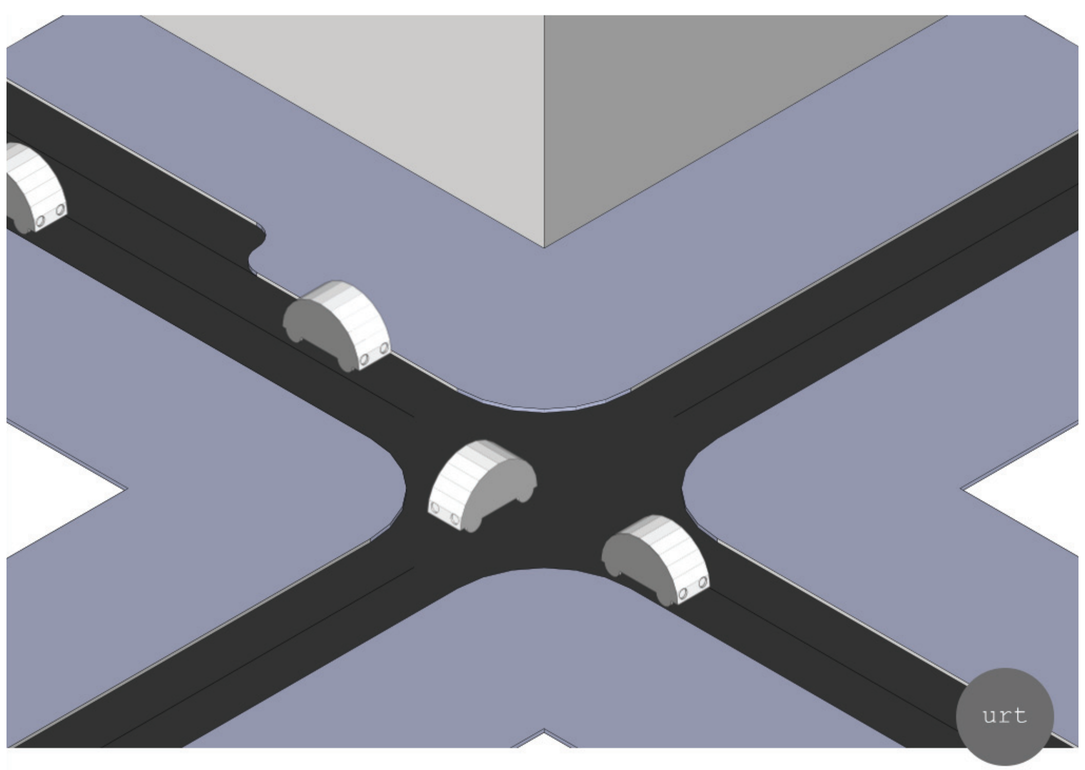
--the analog intersection

(view animated clip)

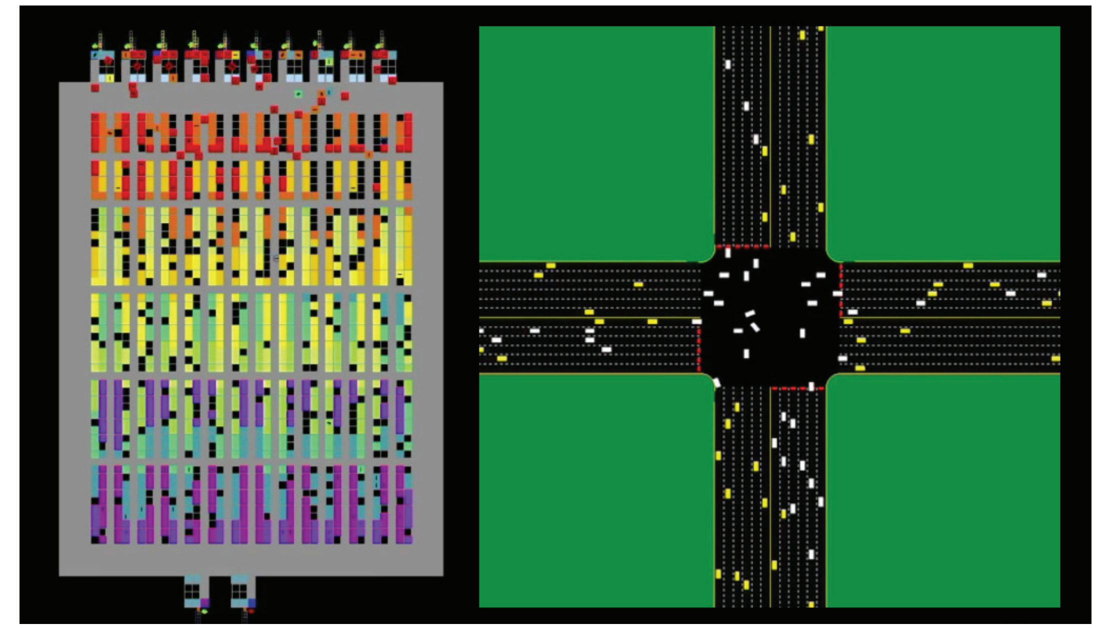


--the autonomous intersection

(view animated clip)



ref:
Peter Stone
Sean Dockray + co



--kiva warehouse floor vs autonomous intersection

(view online)

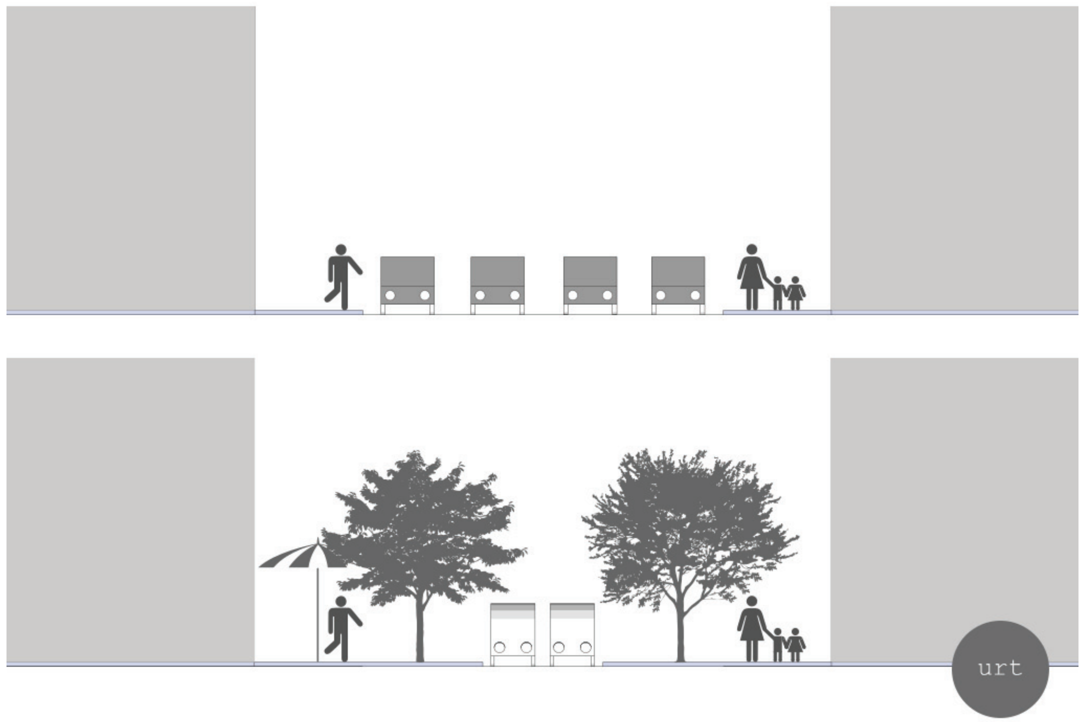
autonomous intersections

Autonomous vehicles will redefine the intersection. Junctures of traffic would be governed by an emergent manager, enabling traffic to whiz by each other, platooning in a seamless nonchalance. The analog, or even binary, system of green and red lights would be obsolete. Along with traffic lights, stop signs and other directional signage would be unnecessary. The net efficiency of the autonomous intersection can only be reduced by man, the pedestrian, or the cyclist.

--Over time, the traffic cop was slowly transformed: his hands took on white gloves for visibility; his voice was replaced by a whistle; and eventually, he was elevated in a tower and communicated with the traffic via signs or coloured lights. The police officer slowly vanished, his body evolving into mechanical and electrical devices. His hands were replaced by standardized, colored signals. His eyes were replaced by sensing actuators, such as microphones, pressure sensors, electromagnets, or video cameras. All that was left was to replace his brain.

--an extract from “Blocking All Lanes”.

salvaging the sidewalk

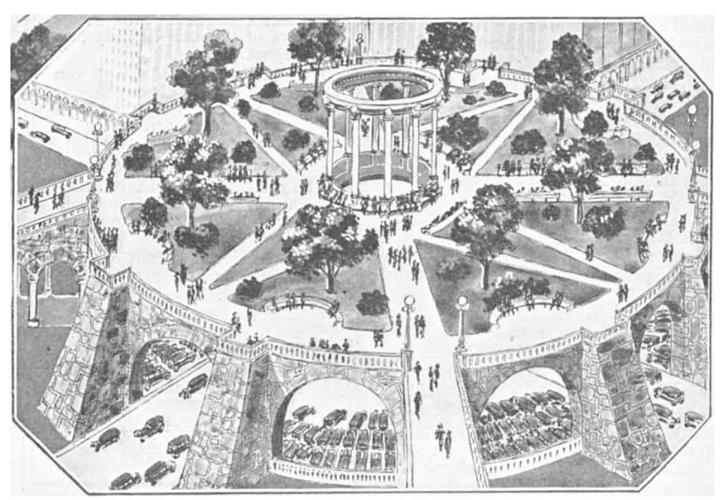


--A traffic jam with no emissions is still a traffic jam.

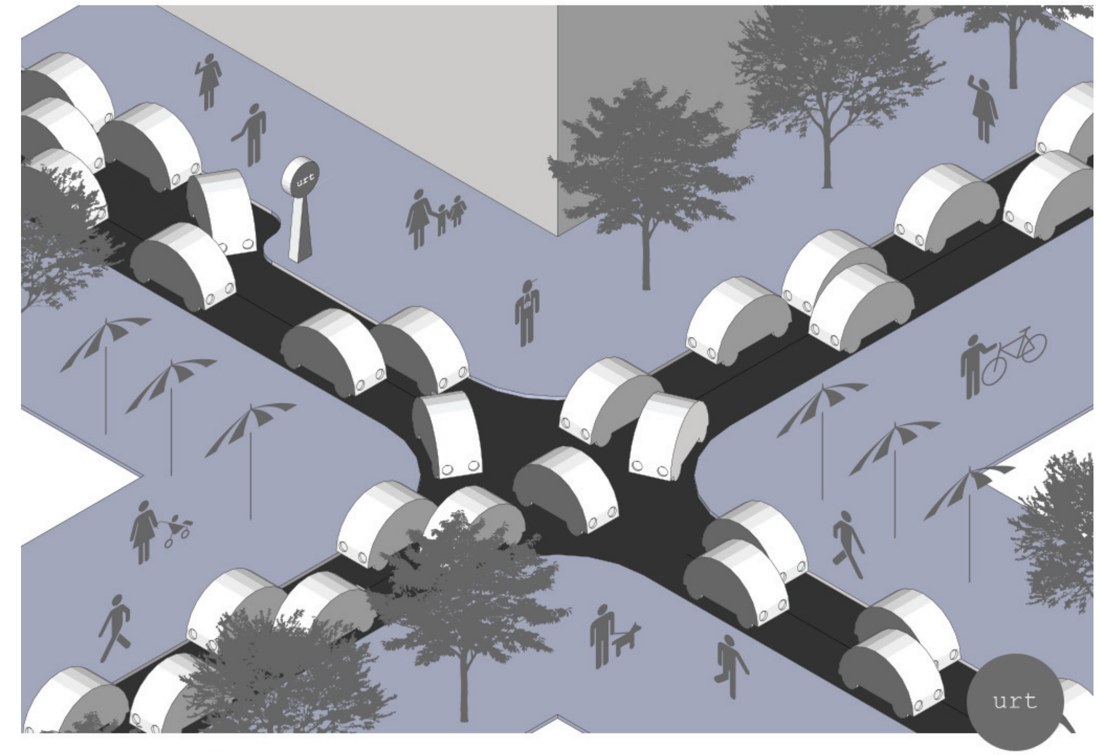
--Traffic jams are just a symptom: global gridlock is going to stifle economic growth.

- Bill Ford

--Elevated Parks
Harvey W. Corbett,
Popular Science,
August 1925



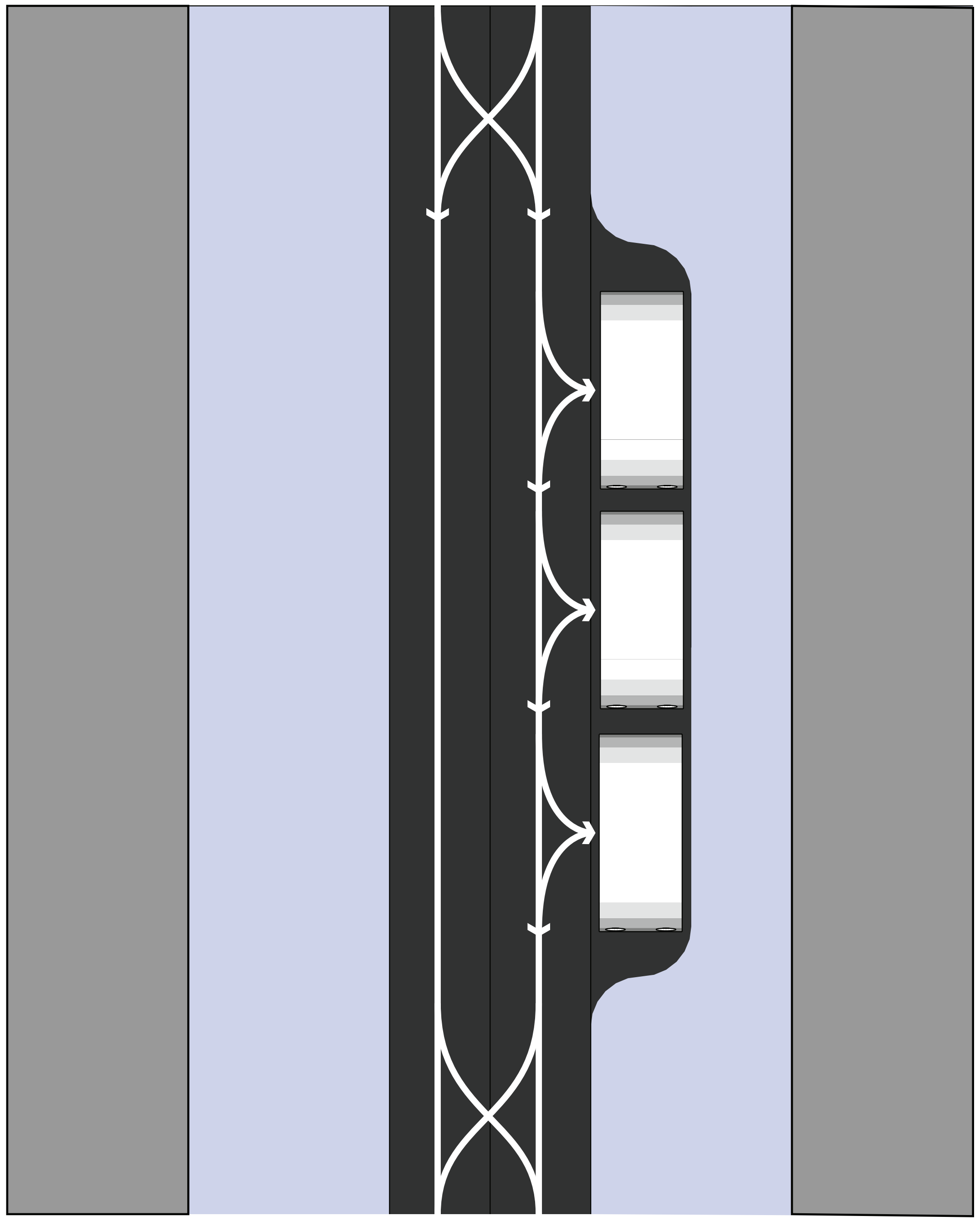
Revitalization of the city is an organic process, as are the inevitable elevation of sidewalks and the multi-tiering of the cityscape. Modal segregation of pedestrians from the mobile vehicle network will increase the average individual's safety without disrupting the efficiency of the traffic flow, plus enable the growth of parks, tree-lined boulevards and an outdoor economy.



--revitalized sidewalks

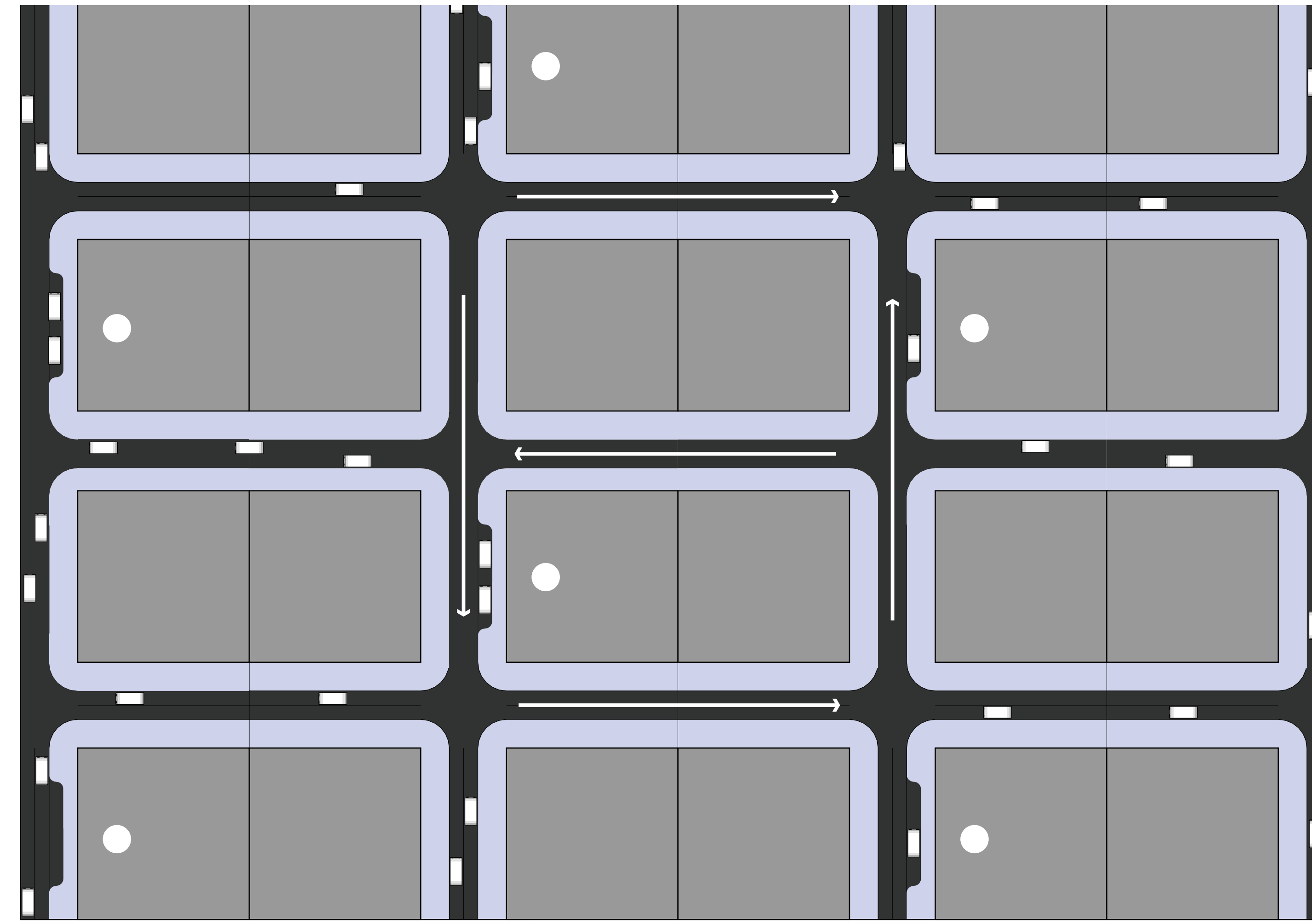
--optimized, raised pedestrian intersection

docking + planning



--docking
ingress + egress

URT needs to be highly maneuverable within a dense cityscape, especially to reduce its physical impact on the city when docking. URT would need to dock at stations or stops, to either pick up or drop off passengers, or potentially to get a quick charge. The system would also be aware of bypassing traffic, so as to allow an URT vehicle to efficiently sneak out

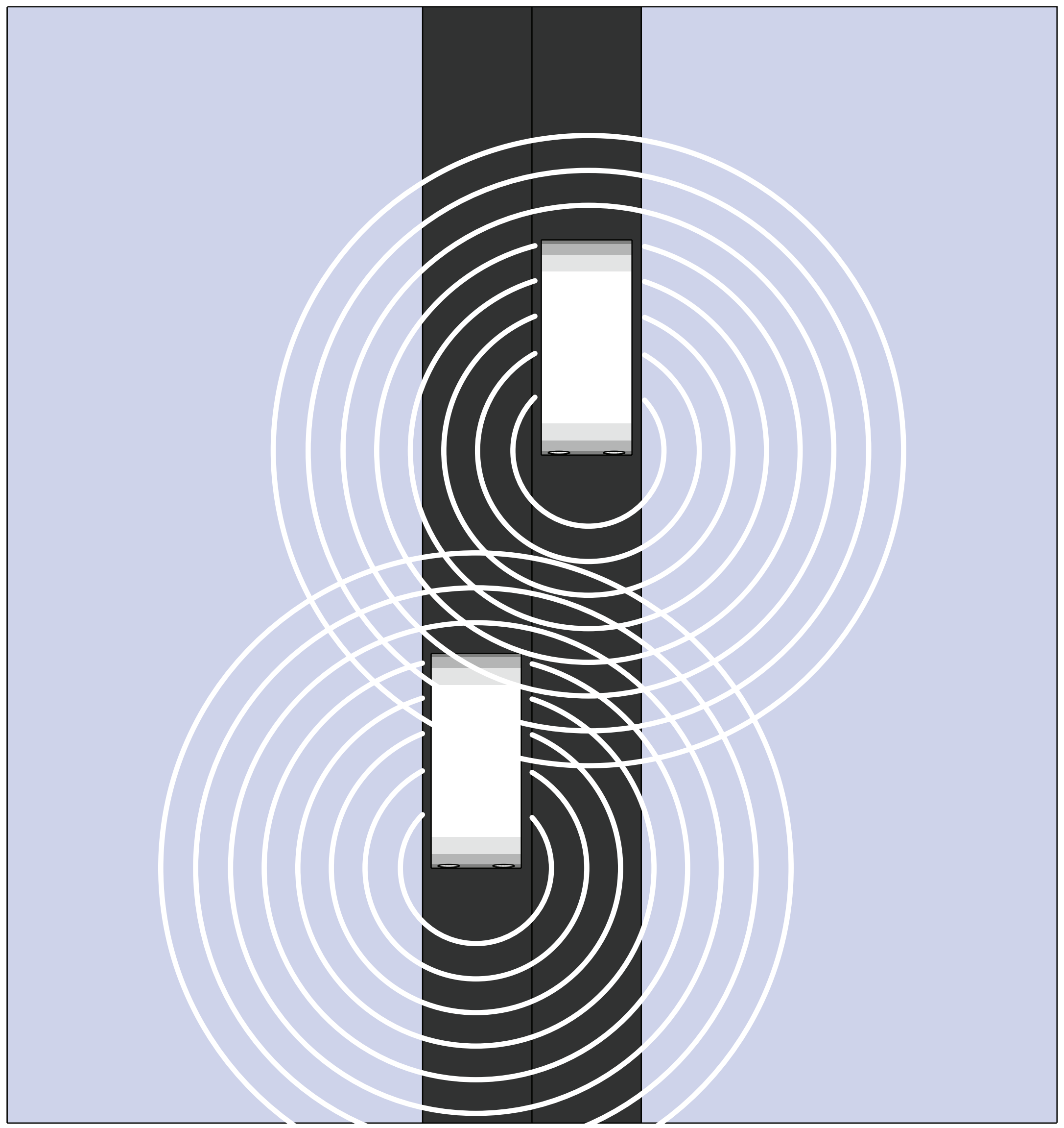


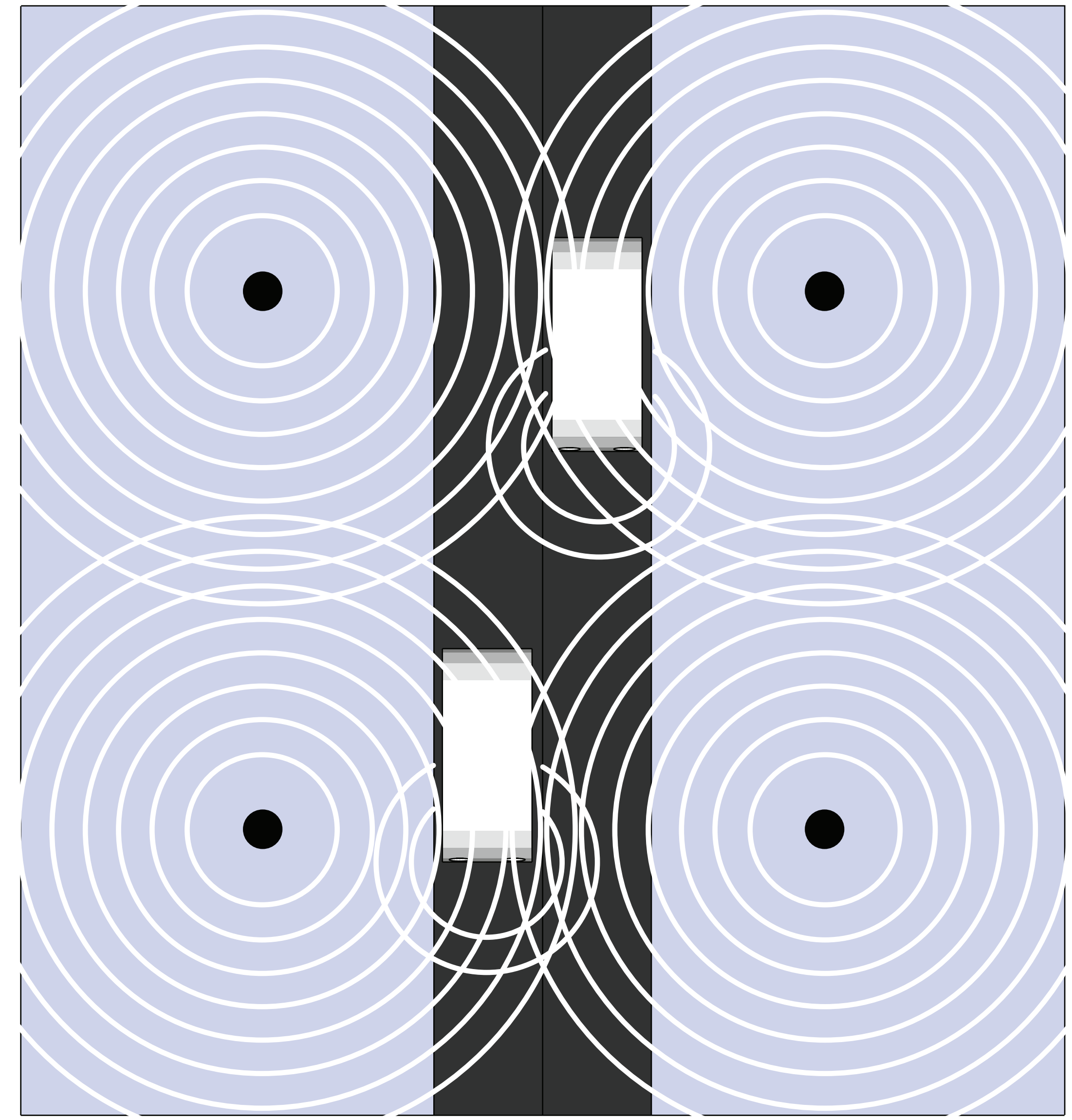
back into circulation. The faster a URT can enter and exit a docking station, the less spots the docking station would require. Commute part II will explore the steering and maneuverability options of URT.

--city grid layout
for docking
stations and
direction of travel

For urban planning in the simplest scenario, we'd adopt a NYC-esque grid layout, with strict, alternating one-way streets. However, placement of stations would be staggered every other block, on the short end. This promotes a slightly more pedestrian city, with the furthest distance between stations being a little more than one long city block. By designating stations and limiting their occurrence, it allows both lanes of traffic to flow with more consistency, rather than get bottled necked as passengers casually alight.

--vehicle-centric sensors, independently detecting environment and other vehicles





--environment-centric sensors, remotely detecting environment and relaying data to vehicles

centralized vs decentralized

Like Google's driverless car, vehicle-centric wayfinding enables the vehicle to have full autonomy over their environment and gain a slew of independence. These vehicles could go off-road if they wanted to, on a whim, as they are essentially trailblazers. The Google-esque car would require a multitude of sensors and gadgetry, weighing it down; raising the cost and impact on the environment as their hardware and data isn't remotely shared with other vehicles in the vicinity.

City-centric sensing and detecting scatters nodes across the urban landscape, assuming the bulk of the responsibility, much like a mobile phone depending on reception. However, the overlap of the network area of the nodal sensors/transmitters should help qualm issues concerning connectivity. This method reduces a large amount of the hardware required in the vehicle, keeping it minimal but imprisoning it to the confines of the urban perimeter.

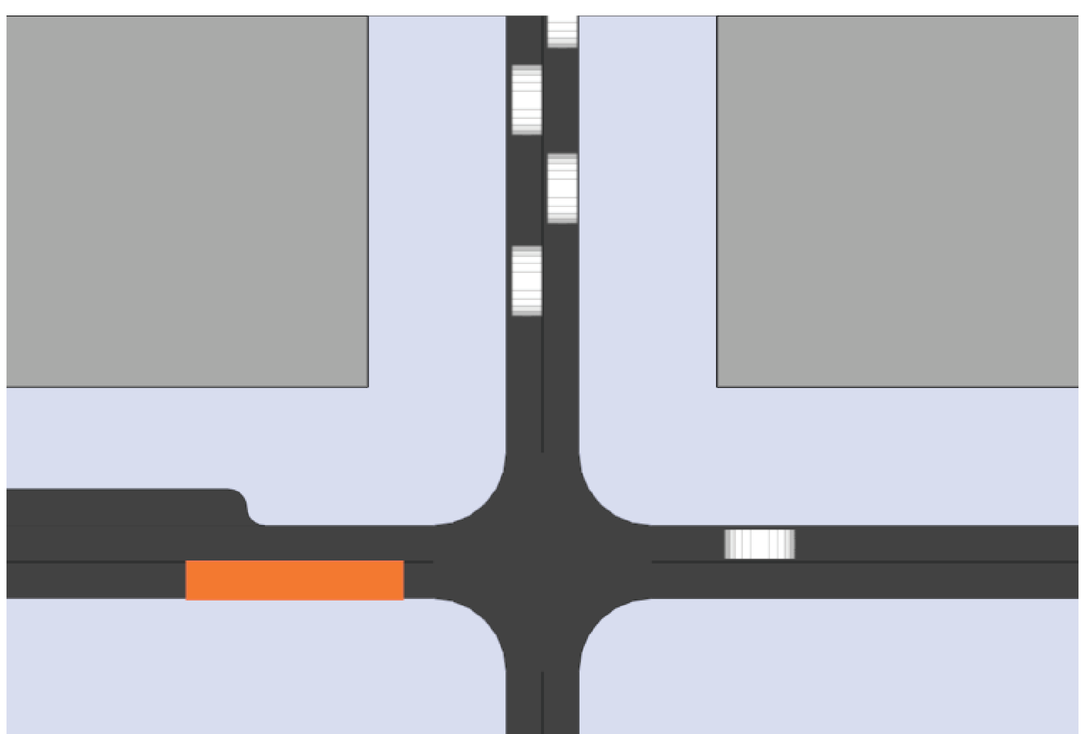
chassis standardization

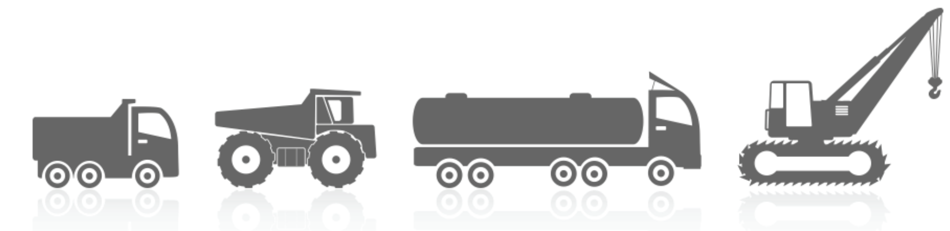
For a system to be inherently efficient, the sum of its parts must be greater than the whole. For URT, standardization of its units ensures modularity and industrial prowess. The chassis for vehicles partaking in the URT ecosystem must adhere to standard dimensions, hardware, network and connectivity. This certifies a level of quality control and reduces liability.

For utility and auxiliary vehicles, such as municipal services, or manually operated vehicles alien to the URT network, allowances will be made to share the road, with work and travel zones allocated. These tertiary vehicles can attach a beacon or relay that indicates its presence and mobility amongst the busy hive of URTs. A regulatory board would enforce the specialization of drivers, ensure permission was granted prior (similar to entering airspace), and monitor procedure such as adhering to the speed limit. The emergent URT system will recalibrate optimum routes and bypass or reroute traffic so as not to cause congestion or delays due to the “outsider”.

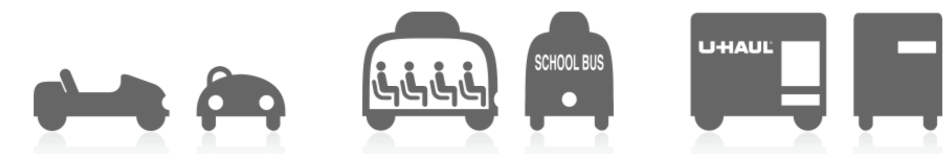
--manual vehicle integrated into an autonomous system

(view animated clip)



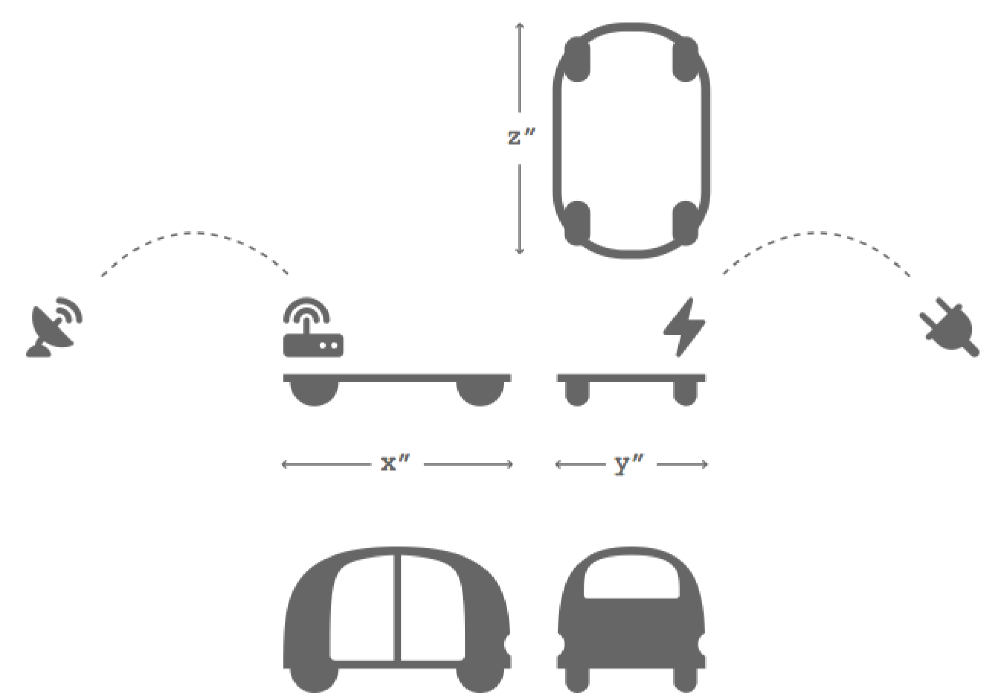


utility, auxiliary, and manually operated vehicles



customization: personal and business

commercialization and advertising



chassis, hardware and network standardization

To circumvent a modernist, dystopian banality, the chassis design and manufacturing can be open-source to promote a competitive marketplace while still adhering to strict regulatory requirements, just as our current DOT standards demand. This allows for a plethora of customization opportunities, both for personal vehicles and for business. Though not mentioned prior, the URT platform should still cater for the option of private vehicle/urt ownership, with the entrenched hope that its efficiency and comprehensiveness would promote a culture of sharing whilst significantly reducing the net volume of privately owned vehicles.

External aesthetics, even for the public transit units, can be decked out much like our modern taxis or buses, each individually gaining a fair share of advertising revenue. For smaller closed loop systems, URTs can be symbols of their institution, campus or city.

the hackney carriage

In considering designed interiors of the URT, one can ply case studies from existing successful models. The hackney carriage, a spacious, flexible taxi of British heritage is a prime example of well-conceived interiors. Its facing seats

LTI TX4

ref:
The London Taxi Company

--bird's eye view of a London Cab

--remove the driver and trunk

enable social interaction and conversation, while the rear-facing seats have the option to fold away, facilitating wheel-chair accessibility.

Using this framework, one can build upon features unique to URTs usage. URTs ceaseless utility demands a rigorous cleaning regime, and thus a durable surface, both exterior and interior, must remain continuous, watertight and seamless, familiar to that of a bathtub or a plastic lawn chair. The vehicle’s maintenance routine would be entirely automated as well.

For security and safety, URTs can be individually outfitted with CCTV and surveillance. In the absence of a taxi or bus driver as the voice of authority, surveillance helps combat vandalism, retrieve lost items, or acts as an instrument of national security. URT’s interior can be void of compartments or recesses in which articles could potentially be stored to be carelessly forgotten.

--flexible capacity of urt concept

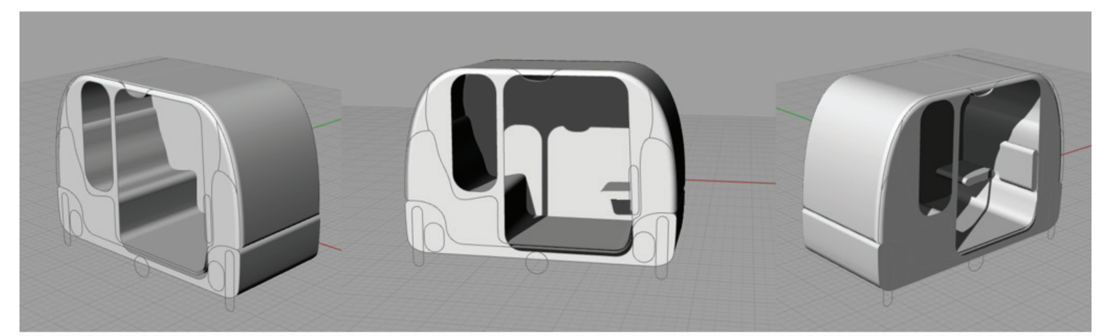
5 passengers

3 passengers + a bike

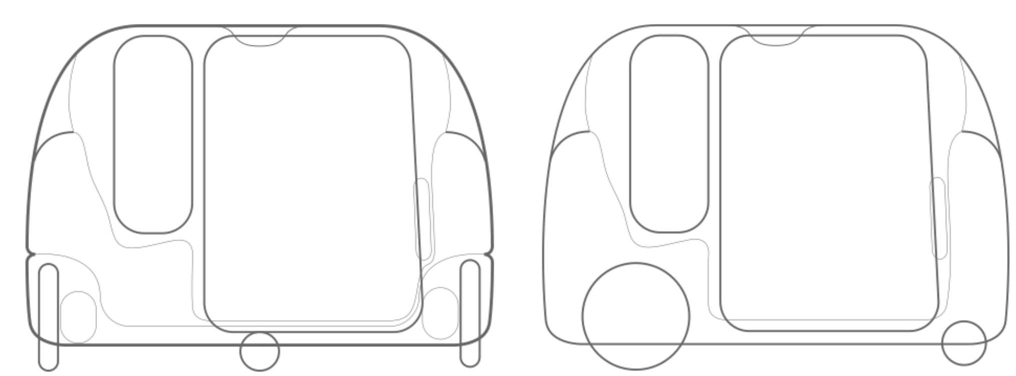
4 passengers + a wheelchair

ref:
The London Taxi Company

LTI TX4, Interior



--concepts for “continuous surface/washable” interiors and exteriors.



location cards

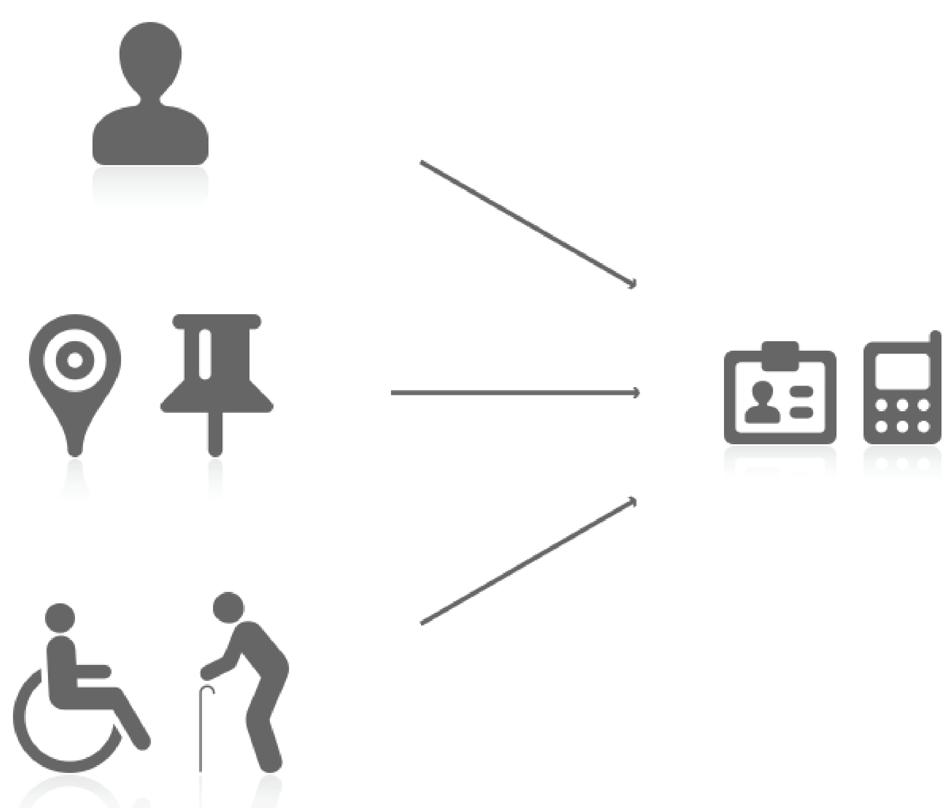
user interaction

To enable faster navigation and reduce the amount of time playing with the vehicle's interface, we can create location cards. Location cards either have a barcode or RFID embedded, simply denoting an address. The user simply taps the card upon entering the vehicle and it sets off driverlessly. Apart from business cards being embedded with this concept, users with frequent destinations can perhaps keep them handy on a keychain. Additionally, transit cards or IDs can be embedded with user preferences, favorite destinations, or provide special services for the elderly or handicapped.

user preferences

preferred destinations

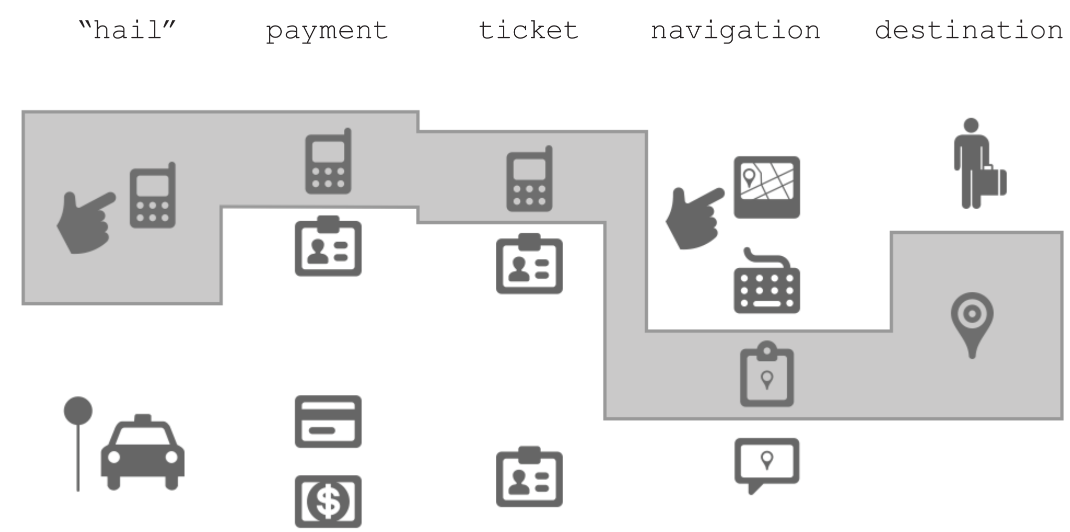
special needs



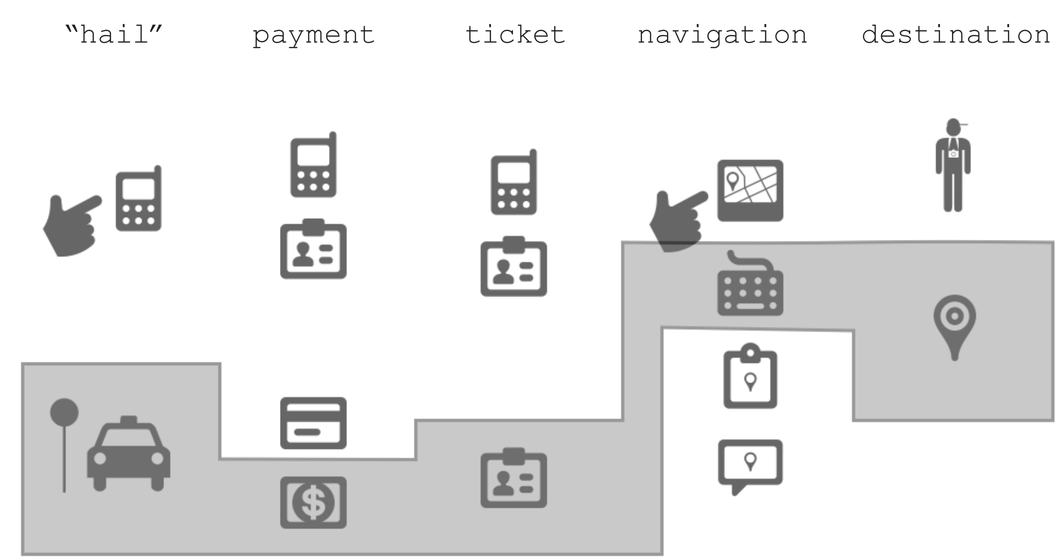
user interaction cont.

Different types of users also have different needs, and access to varying technologies or forms of currency. For example, a businessman, a heavy commuter, has all his data, including his ID, credit cards and his transit ticket, saved on his smartphone. A tourist however, has no local phone, no identification, only liquid cash and an address scribbled on a napkin.

commuter's interaction



tourist's interaction



--approximately 70 percent of workers who commute by transit earn less than $25,000 a year.

user interaction cont.

The introduction of money to the user experience of using driverless vehicles is rather tricky. Apart from cars meekly being free, the simplest method is the adoption of a "zipcar" like procedure: become a member, book in advance, and rent by the hour.

UltraPRT's pods at Heathrow are a free service, but only exclusively serve British Airways Business Class passengers. Additionally, the system is neither complex nor mobile, calling at only three unique stops. Google's golf cart system is also free, so while they have the most progressive mobile technology, they have yet to capitalize on it.

The introduction of money means that transit has to be fair, equitable and valued, both in ease of use and timeliness. Time is money, and especially on public transit, time is not mutually exclusive and yours affects everyone else's time.

--Johnny Cab,
Total Recall,
Paul Verhoeven,
1990

(view clip online)

ref:
Erin Chantry

Value allows one to redesign the entire experience and interaction, and mitigate a balance between freedom, a variety of choice and simplicity.

--Google's Prius, "how engineers drive"

--UltraPRT station interface

user interaction cont.

Variables include, not exhaustively: breadth of service, number of destinations, and population of user. The larger the area covered, the more destinations usually available, the higher the foot traffic from the larger market. Choice becomes harder to mitigate effectively. The more destinations available, the more options and the more information available to you, the more time it takes you to go through it, and understand it and react/interact with it. The time adds up, queues form, delays will happen.

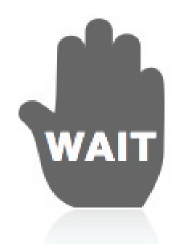
special features

Route optimization and interactive media present a couple of opportunities to integrate innovative features, like medical evacuation, personal preferences and entertainment:

waiting for another passengeger to enter

waiting to load/unload

increased fare rate // special needs pass



physical button for emergency stop

fine for misuse

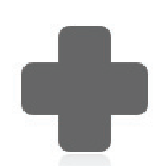
--We gave up paper maps for digital navigation systems.
- Tom Vanderbilt

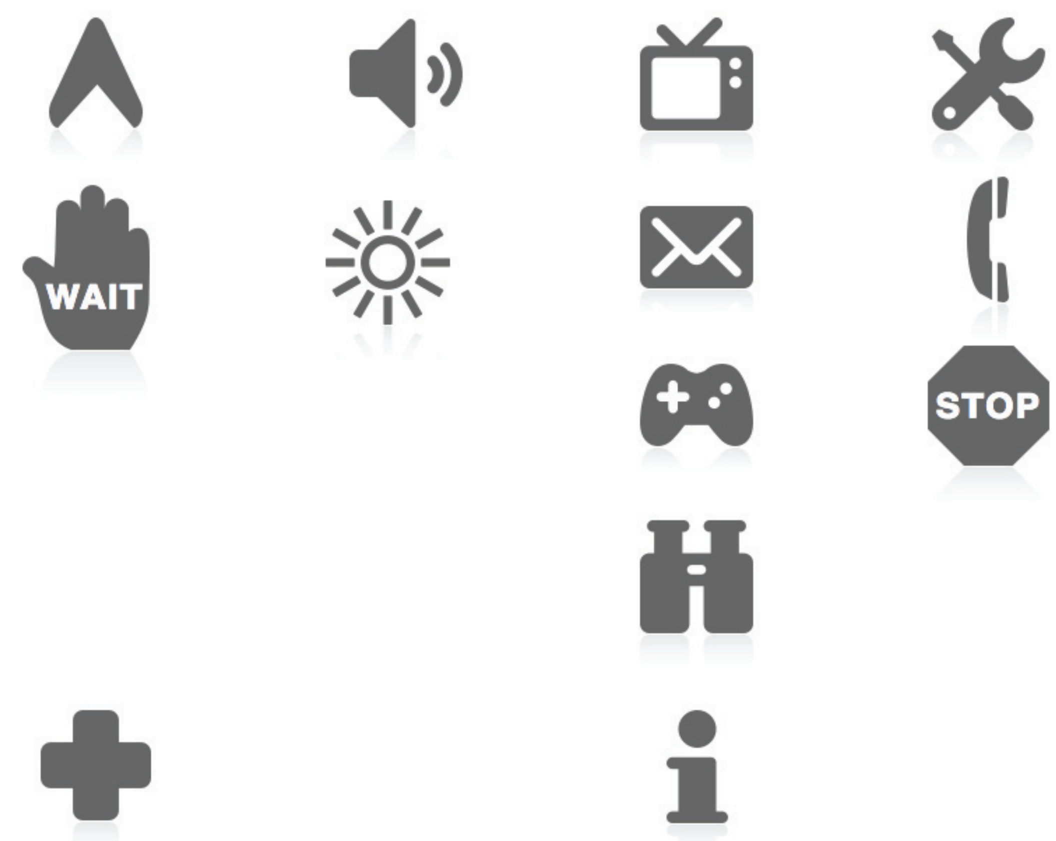
medical emergencies

prioritized routes

preset hospitals of choice

increased fare rates





columns from left to right:

navigation buttons + medical emergency button

ambience preferences, lighting and volume

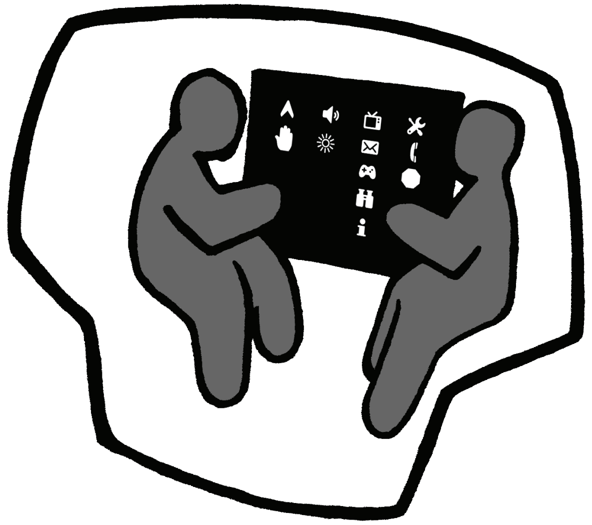
entertainment, tv, browsing, mail, games, tourism and info

repairs, assistance, emergency stop

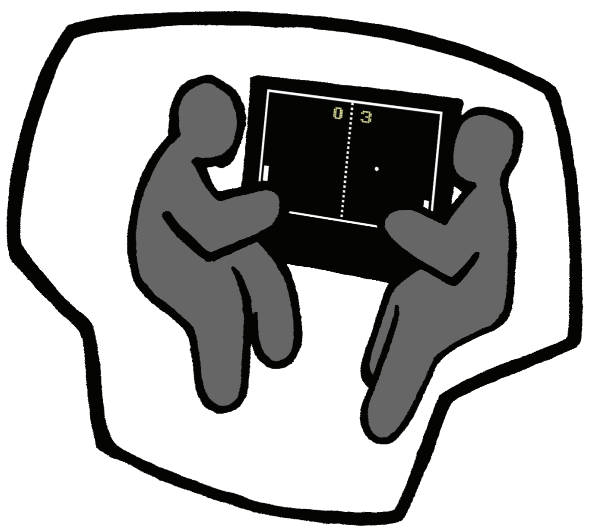
To minimize the presence of a comprehensive, remote diagnosis soft/hardware per unit, non-regular superficial repairs and maintenance can be crowd-enabled by the users:

--live repair feedback, based off PBSC's bixi bike repair feature

--using an onboard navigation and entertainment interface



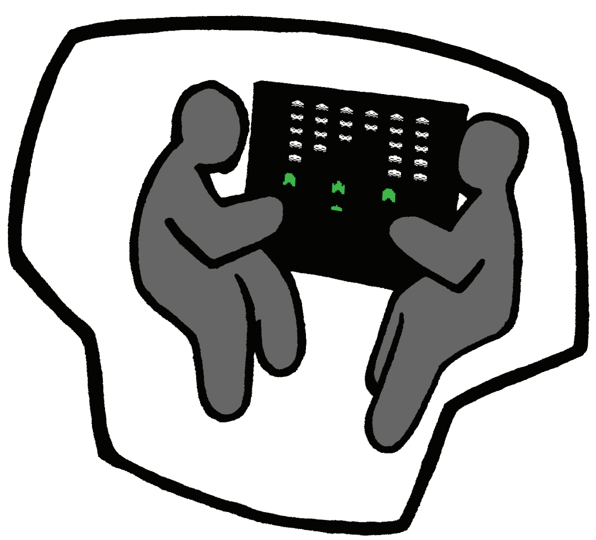
--Any man who can drive safely while kissing a pretty girl is simply not giving the kiss the attention it deserves.
- Albert Einstein



--playing Pong

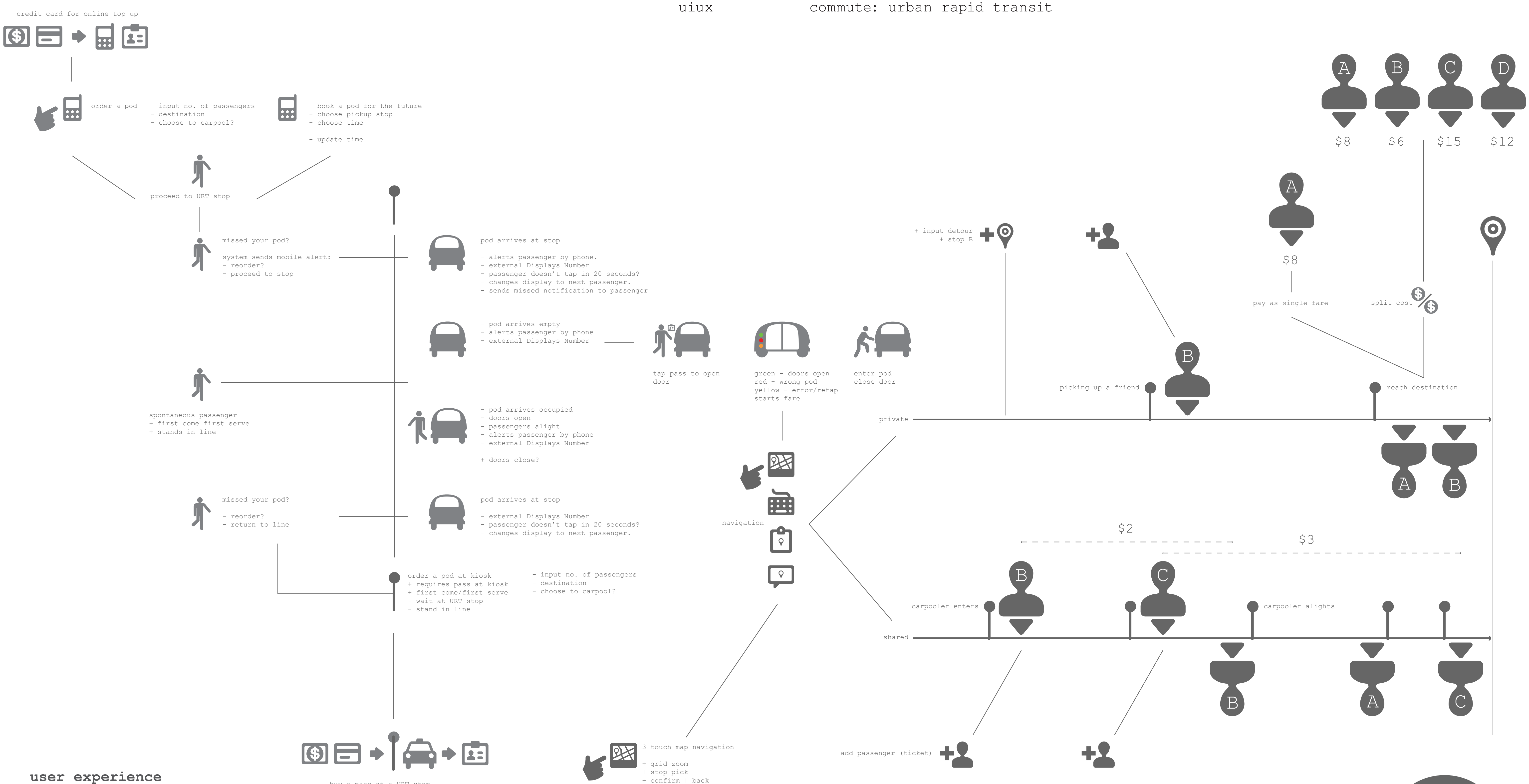
--Maybe the problem is not that texting and Facebook are distracting us from driving. Maybe the problem is that driving distracts us from our digital lives.
- Tom Vanderbilt

--playing Space Invaders



--so much of operating a vehicle, or driving, is the sensation of it, and it embodies far more that an expression of tactility

ref:
Robin Chase



user experience

closing A recent obstacle in the design process, at least at the time of printing, was a relatively unassuming one: doors.

Subway doors open and close according to schedule: to enable the train to move on schedule. Passengers have already paid for their tickets by the time they've reached the platform, and their presence on the subway car is of no concern or inconvenience to anyone else. Doors remain open long enough for passengers to both alight and board.

Taxis, however, start charging the moment someone enters the cab. How long it takes for the passenger to decide on a destination is of no concern to the cabbie as he/she is making money, prorated, simply with their time and presence, nor is it a concern of the traffic maneuvering around them.

Urban Rapid Transit shares the same responsibility as a business's inventory; it needs to be always moving in order to stay efficient and profitable. The longer it waits at a stop, the less capital can be shared and the more it is squandered.

For URT, to start the meter the moment the door opens and they enter, can mitigate the inefficient cost of a passenger

--Boris Johnson on a London double-decker

A Trip Down Market Street, San Francisco, 1906

(view film online)

leisurely attempting to navigate. However, that would require the door to close after the previous passenger alights, then reopen again, wasting both time and energy remaining idle. Leaving the door open, as a default, allows for anyone to enter and take a nap without choosing a destination.

The other option is for the user to pre-select their destination. However, the most fluid form of this requires the mass demographic to proficiently use and extensively adopt smart mobile technology, furthermore excluding the ability to casually, spontaneously or immediately flag a vehicle.

To resolve this issue, I looked for inspiration from both this image of Boris Johnson on a double-decker, and this video of San Francisco's Market Street in 1906. The fluidity of vehicles and people intermingling effortlessly can be compared to the enduring tradition of casually hopping onto the back of a London bus as it rolls by. Public transit needs to embrace a certain nonchalance and spontaneity in it's trivial usage, and Urban Rapid Transit shall attempt to do it autonomously.

references and acknowledgements

Anthony Levandowski
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Soojung Ham
Syd Mead
TED
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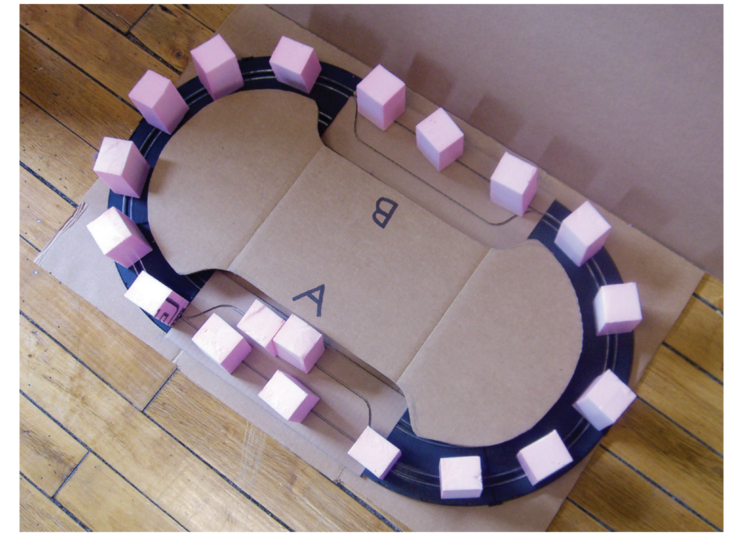
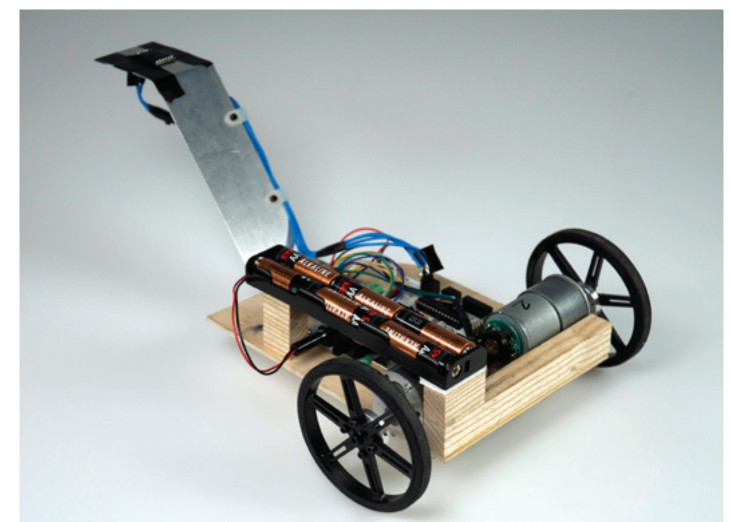
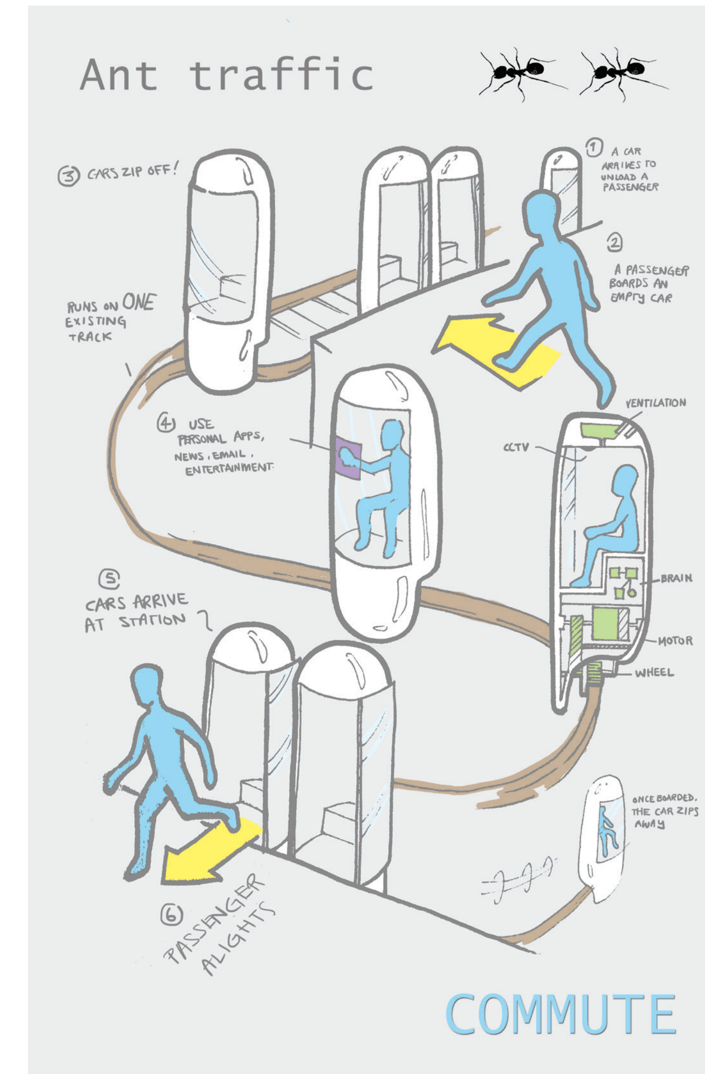






left to right:

--studies for a subway bypass station.

RISD ID 2009
Jerome Arul

--cubscout, a navigation platform, using encoders motors, a compass sensor, and a RFID reader mounted underneath the chassis.

RISD ID 2011
Jerome Arul

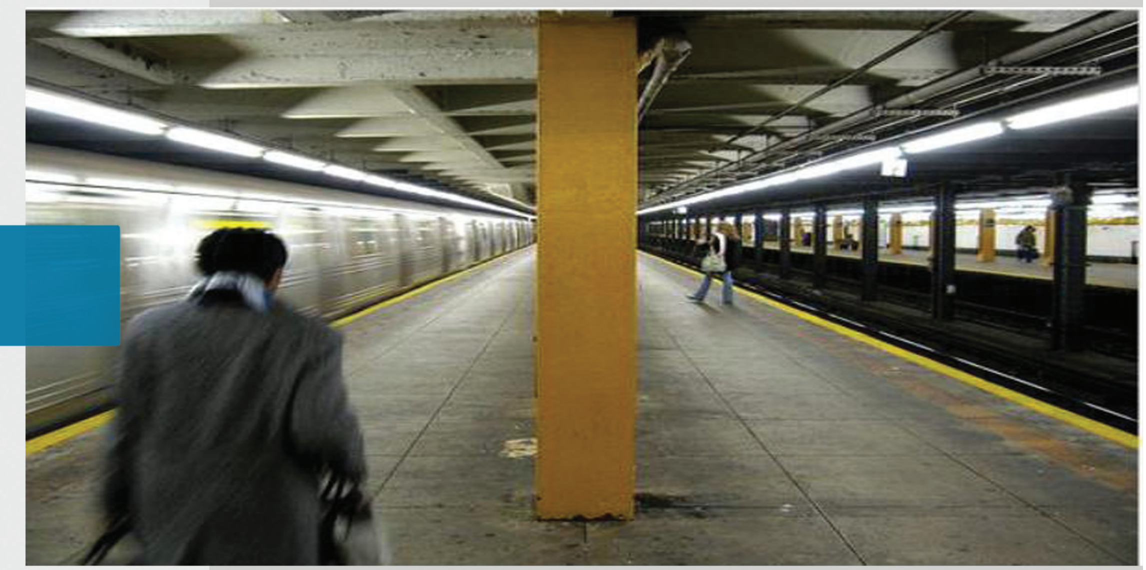
--preliminary concept for the revitalization of subway lines, using single tracked prts, mimicking ant behaviour.

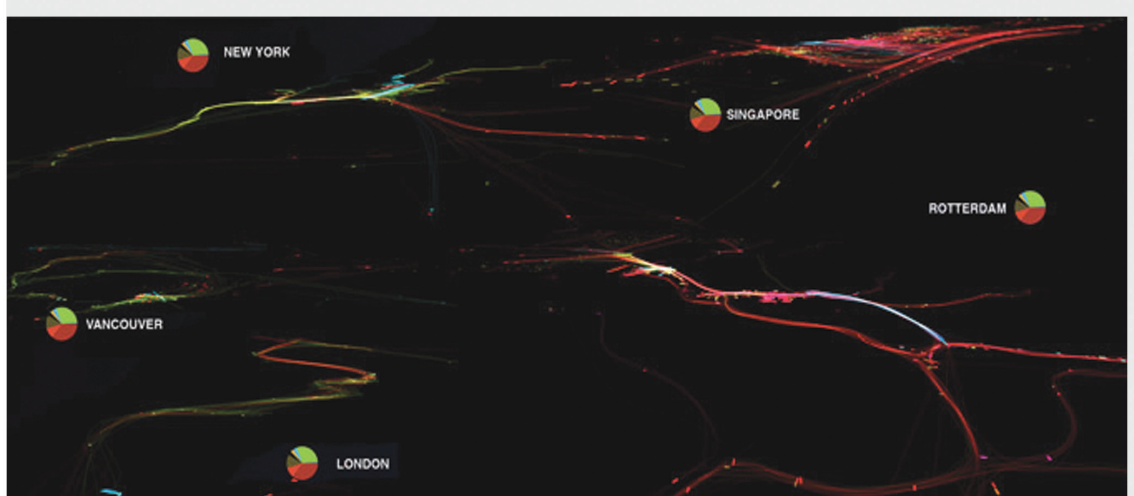
RISD ID 2009
Jerome Arul

"So far, we have failed in designing a real alternative to the car. When you compare the bus and the car as experience, there is a clear winner and loser. Why does my minivan have 17 cup holders –but my bus has none? Why is my bus shelter not heated, but I can start my car remotely and let it warm up? Why is my bus uncomfortable and noisy, when I can listen to Beethoven in my car in relative silence? My bus is a design failure. It's a stick painted green, and out of desperation or inspiration, I'm supposed to want the experience. In Toronto, the slogan of the transit company is "the better way." Well, actually, no. Its not the better way, and everyone knows it.

--initial problem proposal for COMMUTE, a biomimicry project.

RISD ID 2009
Jerome Arul





Until we design a bus experience that is more attractive, more effective, and more elegant than the car, we will be selling a losing proposition. The same applies to the car itself. We must imagine and redesign the car as a product with positive impact, and not make our design objective a car that is less negative. We must design an ecology of movement options that are thrilling in every way, and that also fit together as an ecological, sustainable–but most importantly, sexy–system."

-Bruce Mau

COMMUTE

commute: urban
rapid transit
part I
1st edition
senior studio 2012
RISD industrial
design

jerome arul

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