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The road not taken

How we found (and lost) the dream of Personal Rapid Transit

By Adi Robertson

Half a century after its heyday, the Alden StaRRcar clearly wasn’t made for its world. It looks like a white flatiron with wheels or a sleek, plastic bullet, dwarfed by the regal

sedans of 1960s Detroit. It belongs in one of Buckminster Fuller's domed cities, a vehicle for traveling under the geodesics of a bubble-topped Manhattan. Its future wasn't one of highways, but of narrow cement tracks looping gracefully between city and suburb, connecting increasingly alienated parts of the American landscape.

Once considered a key to solving urban blight, the StaRRcar was part of a public transit revolution that never was — but one that would help launch one of the weirdest and most politicized public infrastructure experiments of the 20th century. It's an old idea that today, in an age of self-driving cars, seems by turns impractically retro and remarkably prescient.

And it all started with a pile of mail.

It was the 1950s, and William Alden's job was teaching machines to act more like humans. A Harvard Business School graduate with an industrial engineering background, Alden had been recently fired from the family's electrical equipment business — his father, he recalls, urged him to "get out into the world and learn the hard way." After using his severance pay to start a small consulting company, he'd gotten a contract debugging Mail-Flo, a promising Detroit pilot program for automated mail sorting. Mail-Flo replaced manual labor with conveyor belts that pushed letters into piles based on which mail truck they'd be put on. While figuring out how to route letters to their destinations, Alden imagined using the same system for something bigger. "I said, well, if you can do that with trays of mail, why can't you do it with people?"

His epiphany had come near the peak of the American automotive renaissance. In the years following World War II, car ownership climbed rapidly: there were roughly 40 million automobile registrations in 1950, and 60 million — or one car for every three people — a decade later. Much of it was thanks to a federal government that had thrown its weight behind the auto industry. In 1956, President Eisenhower signed the Federal-Aid Highway Act, putting $25 billion ($218 billion today) towards linking roads across the country into one massive interstate system. Mass transit funding, by comparison, languished.

The system was designed to be everything that existing public transportation wasn't

But as cars became a fundamental part of American society, shaping everything from the way we eat to the way we date, their rise came at a cost. As suburbs grew, a new influx of commuters choked urban roads built for traveling around a city's core. Air pollution became so extreme that Los Angeles considered declaring a state of emergency during its 1950s "smog sieges," when noxious clouds forced residents to breathe through handkerchiefs or even gas masks. And cars made the growing crisis of urban blight even more stark, letting more affluent residents abandon cities as soon as working hours were over and deflating middle-class demand for buses and subways.

Alden finished the Mail-Flo contract, but he kept picking at the idea of an automated transportation network for human beings. He was one of several inventors who had hit on an idea that was known as personal rapid transit, or PRT — a novel and elaborate combination of rail and car.

PRT's invention is attributed to a transportation expert named Donn Fichter, but the central idea was conceived, remixed, and adapted by many in the 1950s and 1960s. While the details varied, the prototypical PRT system was a network of narrow guideways populated by small passenger pods. When commuters arrived, they would hit a button to select a destination, calling one of the pods like a taxi. Then, instead of running on a set line, the pod would use guideways like a freeway system, routing around stations in order to take passengers directly to their final stop.

The system was designed to be everything that existing public transportation wasn't. Pods would carry only as many people as an average car, guaranteeing a nearly private ride. Riders wouldn't need to follow a timetable or wait for other people to enter and exit the system. Because the pods would only be dispatched on demand, cities could run service to many low-traffic areas without worrying about waste. There were no drivers to train or pay, and the pods could run quietly on electrical power instead of with fossil fuels.

The system Alden developed, though, was more than a car-like train — it was literally made of cars. While thinking about his idea in Westborough, MA, he'd met up with a friend who was getting used to a new car commute. It seemed like a perfect example of how public transportation was failing: his friend could have made most of the trip in a train, but he'd have been left stranded (or taxi-bound) when it pulled into the station. Inspired, he added a new feature: his pods wouldn't just take riders directly to their destination, they would drive right off the track when they got there.

StaRRcar inventor William Alden sits at the driver's seat of a prototype. (William Alden)

Alden called his concept the Self-Transit Rail and Road Car, or the Alden StaRRcar. The prototype StaRRcar had two seats and four tiny rubber wheels, capable of handling at least 10 miles at around 30 miles an hour on electric power. When they neared a PRT station, drivers could pull onto a ramp and feel the car lock into a guideway, using a

tongue on its undercarriage. From there, they would punch in a destination and sit back, while the car was whisked along at 60 miles an hour. At the end of the trip, the process worked in reverse, and drivers retook control of the car as it rolled to an exit — unless they wanted to simply leave it behind and walk, letting the car recirculate to another driver.

Around 1960, Alden made his first big leap into public transportation, founding a company to produce and sell the StaRRcar. In a stroke of luck, the US government was doing the same thing. After years of neglect, members of Congress had started pushing to fund federal research and development grants into mass transit. The initial attempt failed, but sponsors earned the support of newly sworn-in president John F. Kennedy, who lamented that "nothing is more dramatically apparent than the inadequacy" of urban transportation. Kennedy didn't call for an end to the huge cross-city roads beloved by people like legendary New York planner Robert Moses, who at that point was trying to bisect Manhattan with a 10-lane expressway. But Kennedy wanted alternatives. In 1961, the same year Alden and colleague Martin Gilvar filed the first StaRRcar patent, Kennedy signed a bill granting $25 million toward mass transit pilot programs — not enough for a national overhaul, but enough to help pique engineers' and cities' interest in reform.

Just as Alden wasn't the only person to design a PRT, he wasn't the only one to hit on "dual-mode" transit, vehicles that worked on both rails and ordinary roads. A 1962 class of MIT students envisioned a similar concept called the Commucar, a traditional-looking sedan equipped with metal arms that could snap into a guideway. But the Commucar was primarily an exercise in mechanical engineering — in a symposium presentation, the professors behind it dryly noted that they could defend "only the educational aspects" of the project. Alden, meanwhile, was shopping his plan everywhere from city governments to the New York World's Fair.

A "traveling living room" where passengers could watch TV or get news articles via fax machine

In photos from the early 1960s, the StaRRcar appears as a running miniature model, with boxy cars small enough to be held in a cupped hand. A few years later, the Alden Self-Transit Systems Corporation had a handful of working full-scale cars, running on a test track in Westborough. Alden printed up brochures advertising a plethora of unique features: a contoured front that would sweep snow off the guideway; a license and registration card that doubled as a key; and a "traveling living room" where passengers could watch TV or get news articles via fax machine, a technology Alden's father had helped pioneer in the 1930s.

Kennedy's 1963 assassination had stopped the president from carrying out his plans for larger mass transit reforms. But successor Lyndon B. Johnson took up the cause with the Urban Mass Transportation Act in 1964, creating a bureau to research and fund public transportation. The UMTA1, part of the Department of Housing and Urban Development,

started work on a series of investigations into futuristic modes of transportation. Alongside short-term improvements for buses and rail systems, it supported new networks like the mostly automated Bay Area Rapid Transit (BART) system. It also took a particular interest in PRT and dual-mode designs, suggesting more work on the complex computerized controls they would require.

Interest was also mounting beyond the Beltway. The 1960s saw an explosion of interest in next-generation transportation, from exhibits like Ford's Futurama pavilion at the 1964 World's Fair to Disney's redesigned Tomorrowland attraction, built to illustrate a "World on the Move." PRT was hardly the best-known idea, but like all automated transportation, it could make for a great magazine cover — and a car that could leave your driveway and effectively start driving itself was even better.

You gulp the rest of your coffee, wipe the egg off your chin, and dash for the door. In the driveway sits a vehicle about the size and shape of a Volkswagen. Beside the door on the driver's side is a handleless hatch. Beneath the car, unseen, are four flanged wheels of smaller diameter than the car's tires. One is attached to the inside rim of the big wheel.

As you slide away from the curb, the sound of the electric drive motor hardly rises above a whisper. A few blocks from home, you steer the car into a special lane, and pull a lever under the dash. The front wheels lock in straight-ahead position. Simultaneously, the side-hatch door slides back and an electric third-rail shoe folds out. It makes contact with a power rail, the flanged wheels roll onto rails of a track, and your car accelerates at a controlled rate of 0.3g. You twirl a dial until you see 'Fifth Street' appear in a small window. Seconds later, as your car enters a main guideway at exactly 60 mph, you open the paper and begin scanning the news.

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In 1967, *Popular Science* published what's probably the most in-depth and accessible article ever written on dual-mode personal rapid transit. It was a front-page story about the "amazing Urbmobile," a design nearly identical to the StaRRcar that had been created by Cornell Aeronautical Laboratories. Based in Buffalo, CAL was an industrial research arm of Cornell University.2 It was also an institution where Alden had tried — unsuccessfully — to poach engineers for his test track.

Three years before *Pop Sci*'s cover story, the Department of Commerce had asked CAL to come up with transportation ideas for the future "Megalopolis" between Boston and Washington, DC. It's not clear whether the resulting Urbmobile concept — a "small, multipurpose electric-powered car" that could drive on both city streets and a guideway — was inspired by Alden, but it's a plausible conclusion. The authors admitted their idea was "by no means original," and they imagined the Urbmobile as a generic super-category for specific models like the StaRRcar or Commucar.

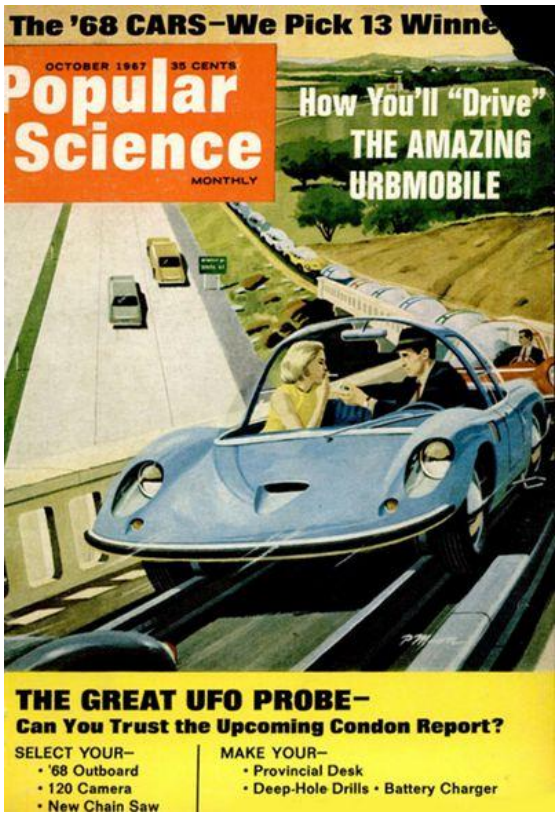
From there, the Urbmobile might have disappeared, but for an unlikely benefactor: *Life* magazine, gathering material for a December 1965 double issue on the plight of American cities. A journalist from *Life* had seen CAL's study, and the magazine offered to provide illustrations of its more impressive ideas: the Urbmobile; an autobahn-esque "Century Expressway;" and a towering transportation hub where passengers could shuttle between cars, VTOL aircraft, and a floating "aquamotel." In turn, CAL would expand on its original proposal with a 270-page report called *Metrotran 2000*, an exhaustive examination of futuristic transportation systems.

In the issue, titled "The US City — its greatness is at stake," CAL's designs occupy four pages, one snippet in a series of predictions for the year 2000. (A vision of homework done by computer panned out; strings of mile-wide skyscrapers connecting every city on the Eastern Seaboard didn't.) It's the light chaser to an issue full of feature articles on slums and suburban sprawl, illustrated with sterile black lines. The Urbmobile is represented by two narrow tracks of boxy cars zooming along as their drivers read newspapers, driving towards a metropolis that stretches out into empty blue space.

James Bareham

But if *Life's* take was a little abstract and detached, *Popular Science* made readers feel like dual-mode transit was just around the corner. Instead of bland, uniform boxes, its cover shows a string of colorful sports cars, speeding over two dull-looking ordinary autos on a freeway below the track. In the passenger seat, a blonde in a sleeveless blouse lifts a cigarette between two fingers, closing her long-lashed eyes. The driver, a clean-shaven company man in a sharp suit and trilby, isn't watching the road. He's leaning out of his seat, offering a light. The message is clear: this isn't *The Jetsons.* If you believe the article, it's the '80s.

Read closely, and the timeline doesn't seem quite so likely. CAL's Urbmobile concept had gotten a $100,000 research grant from the UMTA, but it was only for a preliminary design, not a working prototype. Project lead Robert A. Wolf said that in a best-case scenario, it would be five to seven years before any kind of real-world demonstration could take place, assuming the lab was chosen for a larger transportation pilot program. As far as the historical record is concerned, it wasn't.



For anyone tuning in on TV, the state of dual-mode cars would have seemed brighter. In 1966, Walter Cronkite took a trip to Alden's home for a transportation-themed episode of *The 21st Century*, a forward-looking successor to his acclaimed news program *The 20th Century.* After running through ideas from General Motors and Commucar co-designer Dwight Baumann, Cronkite gets behind the wheel of a prototype StaRRcar on the streets of Westborough, delivering a monologue about the tedium and inefficiency of driving. As he comes to a stop at the test track, his car slides onto the guideway and rattles away on its own. "Maybe I'll bring a kit along and I'll make some coffee," he quips, hands off the wheel. "Or if the seat reclines, I can lie back and grab another 15 minutes' sleep."

But dual-mode systems were increasingly fading from the conversation about PRT. As one of the only people who had actually built one, Alden was soon hedging his bets. "The longer we stuck in the business, it became clear that people weren't particularly interested in the 'roadability' at that time," he says today. By the mid-1960s, Alden Self-Transit was pitching a "StaRRcar Jr.," a more conventional PRT that ran on a closed loop and couldn't be independently driven on surface streets. Before long, the company had established a second test track in Bedford, MA, this one featuring six-person mini-buses that never left the guideway.

If he'd stuck with it, it's not clear that the first StaRRcar could have caught on. "Dual mode has always been something that sounds exciting," says Catherine Burke, associate professor at USC's Price School of Public Policy and author of the exhaustively researched *Innovation and Public Policy: The Case of Personal Rapid Transit.* "[It] sounds wonderful when you haven't done the analysis." But the specifics might have sunk it. In

the late 1960s, the Aerospace Corporation3 started a long research program on personal rapid transit. It quickly uncovered a number of potential problems.

The early days of the Morgantown PRT system. (West Virginia University, Department of Transportation and Parking)

From the start, letting vehicles off the track put them in the hands of people who might not know how to maintain or run them. Project leader Jack Irving worried about the possibility of vehicles malfunctioning, or of delays if the network tried to run safety checks before letting them enter. At the other end, road traffic could end up blocking vehicles as they tried to get off the guideway, effectively shutting down the exit. Even Walter Cronkite's innocent suggestion was dangerous: What happened if he slept through that 15-minute nap, and his car rolled off with no one at the wheel?

If a city purchased a system, it would have to deal with logistical questions as well. Alden imagined a rental program for his StaRRcar, with commuters paying to keep cars in their driveway overnight instead of outright buying them. Others speculated on systems that could accommodate different models of cars, which would have immediately opened up more questions. The UMTA examined the possibility of PRT networks with ferry-like pallets instead of pods, letting riders drive ordinary vehicles onto the network — something that would have required much heavier guideways and still raised the problem of an exit traffic jam. And either method would still reinforce — not dispel — the idea that cars were America's transportation lifeblood. "The dual mode never really caught on," says Alain Kornhauser, director of Princeton's transportation program and a longtime expert on PRT. "It was just thought of as being supportive of the car industry, and most of the PRT… let's say 'interests'… were all focused on trying to find an alternative to the personal car."

While the Urbmobile doesn't seem to have ever gotten further than its first grant, it continued to pop up in proposals throughout the 1960s. A dual-mode transportation convention was held as late as 1976, although its central question — per a luncheon speech by Wisconsin Congressman Henry Reuss — was, "Whatever happened to dual-mode?"

Still, attention overwhelmingly turned to single-mode PRT and more traditional automated "people movers" like monorails. The amazing Urbmobile may have been all

but forgotten, but Alden's bet on transportation would still pay off — albeit with unforeseen consequences.

By the late 1960s, the Urban Mass Transportation Administration's work was in full swing, and it began funding seminars for engineers and officials, looking for the evolutionary leap that would make public transit feel new again. It was one of these seminars that attracted Samy Elias, a recently appointed professor at Morgantown's West Virginia University.

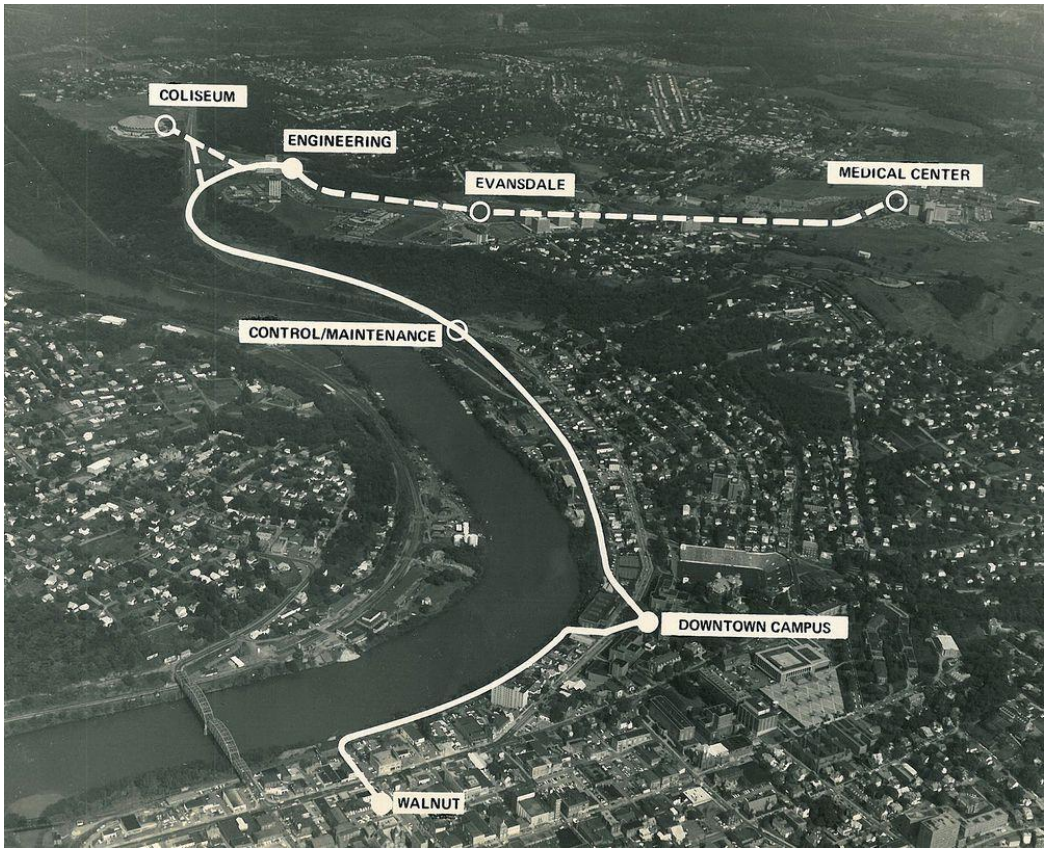
Hired for his transportation engineering expertise in 1965, the Egyptian-born Elias had been immediately unimpressed with his commute. Located in the northeast corner of West Virginia, WVU was expanding rapidly, opening two extra campuses to support more students and a newly established medicine program. Over a mile apart, the locations were further isolated by Morgantown's steep hills, forcing cars into a narrow bottleneck as students attempted to get across town — eventually, the university started barring them from scheduling back-to-back classes on different campuses.

It was the perfect location, Elias thought, for a system that could both bypass traffic and push the cutting edge of automated transportation. So he put in one of the first serious funding requests, asking UMTA for $90,000 for preliminary research. Elias' first proposal, put forward in 1967, was declined. Fortunately for him, though, WVU had the political clout to push federal money toward Morgantown. The school successfully appealed to Senator Robert C. Byrd and Representative Harley Staggers, both powerful legislators that hailed from the state. (It probably didn't hurt that university president James Harlow was the brother of Bryce Harlow, newly elected President Richard Nixon's speechwriter and advisor.)

In 1969, the Department of Transportation — which had taken over the UMTA a year earlier — approved Elias' proposal, funding his search for a suitable system. Alden immediately put in a bid, using the red six-person StaRRcar boxes he'd built in Bedford.

The plan, consisting of six stations and 90 cars connecting all three of WVU's campuses and the yet-to-be-opened Coliseum sports arena, won the bidding process a year later over two other automated transit options. According to news reports of the time, it would require about $14 million in federal funding and be largely completed by the end of 1972.

The date was particularly important. Shortly after taking office, Nixon took a personal interest in automated transportation, seeing it as an achievement that could define his first term as president. His mantra, as Alden puts it, was that if "Kennedy can get a man on the Moon, I can get a man across Manhattan." But the strategy would only work if he could produce a functional system before the 1972 elections.



An early map of the Morgantown system depicts the Coliseum extension, which was never built. (West Virginia University, Department of Transportation and Parking)

From the beginning, there was tension between the university and the Nixon administration, over both the project's leadership and its purpose. For WVU, the Morgantown PRT was an experimental solution to a concrete transportation problem. The UMTA was primarily interested in it as a proof of concept, and its involvement added tremendous political pressure. Before it was even built, Secretary of Transportation John Volpe called the hypothetical system a "breakthrough" and a "great step forward," positioning Morgantown as a make-or-break moment for PRT. And the agency didn't, it seemed, like Alden's design.

The decision was the start of a logistical and budgetary nightmare.

Soon after getting involved in the project, UMTA took issue with Elias' decision to base his network on the StaRRcar. According to Burke, Volpe and other officials went to Bedford to check out the StaRRcar test track, finding a system that was smaller and rougher than they'd expected. As she puts it, "It was like, 'Oh shit. We'll never make this work in time.'" Shaken, they hired NASA's Jet Propulsion Laboratory as lead designers, putting the project up for another bidding round.

Sound or not, the decision was the start of a logistical and budgetary nightmare. JPL's reevaluation turned up a far higher cost estimate than expected, and the administration pushed back, paring down the initial construction phase to just three stations and 15 vehicles. Worried about being "shouldered out" of the program, Alden Self-Transit took its patents to Boeing, which adopted its basic car design and switching technology. Boeing won a new contract, but only for the cars — the control system went to an engineering company called Bendix, which had never worked on PRT. By mid-1971, JPL had dropped out after one too many fights with UMTA. Boeing was now in charge, and construction had yet to begin.

With a year left before the presidential election, WVU and the Department of Transportation scrambled to get the system in a working state, breaking ground for the first station in October of 1971. As the creators saw it, they had one chance to prove that PRT — perhaps even the UMTA's entire mission — was viable. "If this one doesn't work, it will stop mass transit experimentation for at least 15 years," Elias would later warn.

The riding experience hasn't changed much since the Morgantown PRT was built. (West Virginia University, Department of Transportation and Parking)

By early 1972, Boeing had successfully manufactured and run a pod at its own facility in Washington. But construction problems back in Morgantown, including labor disputes and rainfall from the powerful Hurricane Agnes, threatened to delay the project. On October 24th, weeks before the vote, the system was just functional enough for WVU and the Department of Transportation to hold a christening.

Busy with the last stretch of campaigning, Nixon didn't attend. Instead, he sent his daughter Patricia Nixon Cox to preside over what one local reporter said looked "more like a political rally" than a dedication ceremony. Some students showed up to protest

Nixon and the Vietnam War, holding hand-lettered signs reading "PRT Yes, Bombs No" and "Mass Transit, Not Mass Murder." She dismissed them and pledged her father's support for public transportation, pushing a button that set the first car rolling through a red ribbon stretched across the track. After a 10-minute ride, Nixon Cox reportedly pronounced the experience "better than Disneyland," even when a car malfunctioned during the event. For most of the estimated 2,000 people at the ceremony, though, the point was moot — any public opening was still years away.

Over the next two years, it became increasingly uncertain that the PRT would open at all. "When they had that first so-called demonstration, the demonstration was that the damn thing didn't work," says Burke. Weeks before the christening, San Francisco's newly launched BART system — the most visible success of the era's public transit funding boom — had sent one of its cars hurtling past the station terminus and into a sand embankment, raising questions about the reliability of automated transportation and launching a new safety investigation at Morgantown. The first cars had been run, but the real work was just beginning.

The Department of Transportation had committed to funding the first three-station construction phase, but even before the dedication, reports circulated that it might pull out and leave WVU to foot the bill of operating and expanding it. A spokesperson insisted that the agency was just waiting on first-stage results. But as the first stage edged toward completion, it became increasingly clear that they planned to disengage from what one *New York Times* report called a "costly and embarrassing white elephant." The school's board of regents protested that with only half the stations built and barely over a dozen vehicles paid for, the agency had left Morgantown with a useless skeleton of a public transit system. Under increasing scrutiny from Congress, the UMTA offered a compromise: if WVU wasn't happy after another round of testing, the government would pay to demolish it, scuttling the system before it took a single paying passenger.

It was perhaps the project's lowest point, compounded by a widespread disillusionment with personal rapid transportation in general. Congress had requested a probe into UMTA funding and held hearings castigating it for Morgantown's snowballing costs. House transportation appropriations subcommittee member Silvio Conte, one of the program's most fervent critics, called it "the biggest boondoggle that was ever

perpetrated on the American taxpayer." In a reference to theme park "people movers" and a likely unintentional echo of Nixon Cox, he complained that the agency was paying "$33 million a mile to find out what you can find out in Disneyworld." At times, the project degenerated into utter confusion: in one particularly bizarre turn, a UMTA official reportedly suggested abandoning the PRT and issuing students electric golf carts to ride along the guideways.

But Elias and others maintained that the PRT was still viable. And eventually, their optimism — if not their original ambition — was borne out. Later that year, the Senate stripped out the demolition language from a new $6 million grant, and WVU continued preparation for launch, with the Department of Transportation promising to pay the majority of costs for the first year. By mid-1975, the university was testing 20 cars at a time on the track, and Elias said that engineering work had begun on two more stations. He set a tentative date of September 15th for a real launch.

The team missed the September launch date. But on October 3rd, 1975, the PRT finally opened for a two-hour public test window — a long-delayed payoff for over six years of work and $62 million.

Over the next four years, the Morgantown PRT added two more stations and dozens more cars, closing temporarily in 1978 for expansion. There was no doubt that the final 3.6-mile-long track (totaling 8.65 miles of guideway) was a functional transportation system. It cost 25 cents a ride, with a pass included in students' tuition and staff and faculty's compensation packages, and could carry a rider from end to end in around 11 minutes. But it had cost a total of almost $130 million, nearly an order of magnitude more than Alden budgeted in 1969. Because of lingering uncertainty over what system they'd use, the guideways had been built to support heavier pods than Boeing's, making the network seem unnecessarily large and unsightly. And with the bulk of the UMTA's money going

toward Morgantown, other PRT systems had barely progressed beyond the prototype stage. A mass transportation expo held at Dulles International Airport, known as Transpo '72, produced many automated prototypes but few sales. As the project's woes became more apparent, investigation into the UMTA's finances had pushed the agency away from research and into immediate results. On top of everything else, turnover after Nixon's 1973 resignation had gutted the Department of Transportation.

Alden himself was long since out of the picture — the company's work was effectively done after the 1972 christening, which Alden remembers being nearly disinvited from for unknown reasons. After wrapping up work, Alden Self-Transit got what he calls a "token" Department of Transportation contract for more operations research on PRT. But funding for future systems had dried up. Whoever was ultimately to blame for Morgantown's troubled development history, Elias' warning had been right: the age of experimentation was over.

"The name of PRT was just — it's hard to imagine how badly it was damaged," says Burke. Multiple plans for personal rapid transit fell through, whether because of budget problems, logistical issues, or political power struggles. When Denver residents voted to build a PRT system in the early 1970s, the UMTA offered the city money to "very

carefully consider the alternatives" of expanding bus service instead, and the project collapsed. Local disputes killed a similar plan in Minneapolis-St. Paul. Outside government agencies, PRT engineer J. Edward Anderson — who also wrote several invaluable essays hosted on University of Washington professor Jerry Schneider's PRT compendium — blames the conventional rail industry for hampering research into new alternatives, urging cities to play it safe. PRT wasn't the only system that threatened existing interests; during the same period, taxi operators were instrumental in killing a plan for a Las Vegas monorail.

"The name of PRT was just — it's hard to imagine how badly it was damaged."

More broadly, the traditional car's appeal may simply have been too resilient for Americans to give up. "There was really an ideology against public transportation systems," says Marco Pavone, director of Stanford's autonomous systems lab, which covers fields like robotics and self-driving cars. "If you are against public transportation, you're against rapid transit systems." Even outside the US, though, PRT couldn't seem to break through. In Hamburg, Germany, the Cabinentaxi system went through years of testing, only to be canceled in the late 1970s. A test track in Japan, known as the Computer-controlled Vehicle System or CVS, met the same fate. In France, engineers created Aramis, whose PRT pods could cluster together like train cars in order to improve efficiency. After several planning phases, it was finally abandoned in 1987, supplanted by a more straightforward automated rail network.

There were undeniable challenges. Years after Aramis' death in France, sociologist Bruno Latour wrote a postmortem in the style of a murder mystery, uncovering layer upon layer of technological barriers, bureaucratic hesitance, and philosophical confusion. One of its major themes is the conflict between Aramis' utopian efficiency and the messiness of human behavior, the same thing that made projects like the StaRRcar so difficult to foolproof. The first wave of PRT was a machine's attempt to mimic the chaos of a highway system — to run cars bumper to bumper without a crash, to make strangers share a car and hope that no one gets in a fight — with the now-crude technology of the 1970s.

"They were missing the sensors, and they were missing the processing capability on board the vehicles," says Pavone. "The computers of the time were not fast enough to process the vast amount of information that is needed in order to have autonomous driving." To Kornhauser, the issue is less that the technology was inherently inadequate than that it was expensive and inconvenient. "You didn't need that much intelligence in the vehicle to be able to do all this stuff," he says. "The problem was that nobody really wanted to invest the money to build the exclusive guideway. That's the short and the long of it."

To Burke, PRT never even got a fair chance: it was dismissed out of hand as too difficult or expensive, tainted by the memory of Morgantown. She has particular praise for the Aerospace Corporation's system, which was never funded. "There's a ton of details to be worked out, and I have no proof, but I believe it would have worked," she says. "I have

every reason to believe it would have worked, and of course that it would have been improved over time." Her strongest piece of evidence is the Morgantown system itself — and the fact that after 40 years, it's still running.

Visit Morgantown today, and it's not hard to understand the problems Elias saw in the '60s, or why the city was chosen to test a new kind of public transit. It's a town of 30,000 — plus a 30,000-strong student body — strung together by a few major roads that wind around West Virginia's green hills, its downtown streets steep enough to make an early-morning walk in the frost feel potentially deadly.

While Morgantown's PRT never became the go-to mass transit template that Elias dreamed of — and arguably even hurt the development of future systems — it's proved remarkably resilient in the years since. According to WVU's estimates, the track carries 15,000 rides per day during the school year, with an estimated 83 million passengers in its entire lifespan. Since closing temporarily in 1978 for the final phase of construction, it's run on a steady, if university-centric, schedule: weekdays from morning to early evening during the school year, with limited weekend hours and extensions for special events like football games. Students and staff still get a pass included with their tuition or salary; for everyone else, it's an almost suspiciously cheap 50 cents, just 25 cents more than it cost in the 1970s.

"Better than Disneyland" is putting it strongly

Starting a few blocks south of the downtown campus, the PRT cuts a neat line around the university. For three stops, it hugs the Monongahela River that borders Morgantown, until reaching its original terminus at the engineering school. From there, it veers east toward the final two stations, one at the "Towers" dorm complex and another at the school of medicine. The only thing missing from Alden's original plan is a detour to the Coliseum.

"Better than Disneyland" is putting it strongly, but Patricia Nixon Cox wasn't all wrong: the PRT *does* feel slightly like a theme park, or at least unlike any normal public transit system. Instead of the straight lines of a train or monorail track, the PRT is full of loops and slopes, like a very gentle roller coaster. The tiny cars, their eight seats facing each other, create a slightly lounge-like feeling even when they're packed with standing passengers. Running along a guideway instead of being locked onto a rail, they wobble slightly while in motion, reminding you that you're on something closer to an electric minivan than a subway car.

Despite its name, Burke — and others — dispute the idea that Morgantown's PRT counts as personal rapid transit. Its cars are meant to hold up to 20 standing passengers (an annual contest has squeezed up to 97 into one), making the name "automatic group rapid transit" potentially more fitting. The system doesn't always function like a PRT either. In periods of particularly low ridership, it runs a small number of cars through every stop; during peak traffic, it runs direct routes between each station on a schedule, instead of responding to riders on demand.

But WVU transportation and parking director Clement Solomon thinks that the system's on-demand mode is intrinsic to its appeal. After swiping a card or dropping two quarters into a station's turnstile, riders press one of four buttons, indicating the station they're headed for. Once about 15 people select the same location, or at least one rider has been waiting about five minutes, a car gets dispatched. Internal switches direct it through a network of branching underpasses and off-ramps, letting it bypass stations as needed. It's hardly the personal pods that PRT originally promised, but there is a sense that it's catering directly to your needs, not a whole city's worth of people.

"Let me put this two ways: man versus machine. This is the only system where the man controls the machine," Solomon says, when I ask whether the "personal" in PRT matters. "The demand mode — you cannot beat that. No other transit can do that. You're at the mercy of the system."

The university's modest transportation office is at a literal intersection of cars and mass transportation: about a hundred feet from the medical campus PRT station, it opens directly into a 500-car parking garage, which is in turn dwarfed by the vast parking lot outside it. But it's clear which side Solomon, a WVU grad who previously served as the school's sustainability director, favors. An enthusiastic evangelist for personal rapid transit — I leave his office with a PRT-pod-shaped keychain labeled "My Other Car" — he sees WVU's system not as a muddled experiment, but the vital work of extreme early adopters.

"This could have just been a demonstration project, had a sunset, and be done," says Solomon. Instead, WVU turned it into what he refers to as "the heart of the

transportation infrastructure" in Morgantown. "If we took the PRT offline, that would mean anywhere from 30 to 60 buses running nonstop in loops." It's even, he says, a great recruiting tool for students. And he boasts that because of the automated safety system and careful management, the PRT has seen zero crashes in its 40 years of service. An unofficial sixth stop is a maintenance station and depot, where cars can be temporarily steered off the rails and tested every few thousand miles. In 2007, the system was roughly breaking even on its $3 million annual operating cost.

"If we took the PRT offline, that would mean anywhere from 30 to 60 buses running nonstop in loops."

However well it's held up, though, the PRT is showing its age. As the original parts wear out, there's no way to buy replacements; Boeing hasn't been involved in the project since the 1980s. The cost of supporting a dedicated maintenance operation has started growing, even as the system deteriorates. Its reliability now fluctuates between 93 and 98 percent — a source of frustration for both students and WVU, which has deemed the number "not satisfactory."

In 2012, the university approved an initiative that will modernize many of the system's internal components, repair the guideway, and eventually phase out Boeing's original cars. Estimated to cost a little over $100 million in total, the project is about halfway through its second phase, which includes replacing the core of its automated controls with help from French industrial electronics company Thales.

Solomon says that these upgrades will make running the PRT cheaper and far more efficient, reducing the "sticker shock" that people see when they look at its budget now. "When you say 'current maintenance,' you have me, Clem, sitting with my big goggles and a soldering iron trying to replace a board," he says. "The future would mean we just pull the board out — replace the board — because we have commercially available technology." (The cars' circuit boards actually have been replaced, although you can find original Boeing components at the maintenance stop.)

Externally, though, the system remains virtually unchanged from the 1970s — the most obvious difference is a vivid blue-and-yellow paint job on the cars, done almost 20 years ago. Despite proposals to extend the guideways farther from the university, making it a more town-friendly system, there's been no serious move to add new track. And beyond some murals decorating the cement walls, the stations look as retro as their 1960s concept art.

"It's the abstract part that sometimes we struggle with when we talk about modernization, because for the user, it doesn't look like we're doing a whole lot of stuff," says Solomon. "I think the aesthetic stuff is important, but that's the last part." The new cars, for example, won't come until the very end of the upgrade process. "The shell of the vehicle, in some ways, is immaterial to the service that you provide. The key is the

reliability of the system," he says. "You look at these — they're all old and dirty and rusted here and there, but that's not the heart. The heart of the system is inside."

Solomon hopes the Morgantown PRT will still be around until after he's retired, 30 or 40 years into the future. But he also thinks that if the system fails, whatever replaces it will hold to the principles of personal rapid transit. "The concept is never going to be retired," he says. "There's no way you could move people in sort of a congested town like ours at the capacity and the speed in which we can move people. So the type of technology may change, but I doubt if the concept will die."

But Solomon doesn't just think the concept will survive, he thinks it's finally due for a renaissance. And despite the long winter for personal rapid transit, he's not alone.

Beyond all the political and budgetary problems, the guideway may be the single easiest explanation for PRT's failure in cities. Even the most time-tested (and desperately needed) public transit systems have trouble securing space and laying track; New York City's history is littered with unbuilt subway lines that were killed by local protests and a lack of money. PRT guideways had some advantages over trains, like their near-silence, but they would still require cities to build miles of concrete chutes. And unlike a subway line extension, there would be no guarantee that people would accept the new system. Or, as one former transportation commissioner told NPR when asked about personal rapid transit last year: "The last thing you want to do is put up some track all over the place and have it just *there*."

Over the past decade, a new kind of automated transportation has arrived: the self-driving car. Technically speaking, PRT pods *were* a kind of self-driving cars, especially since they used internal controls instead of external switches. But where they were reliant on tracks, the robocars from Google and other companies feel like a complete realization of what 1960s inventors were originally trying to achieve: an intimate but hands-free method of directing riders straight to their destination. Just as pertinently, self-driving cars don't rely on government funding that's increasingly difficult to find — although the 2015 White House "Smart Cities" initiative promised $160 million for cities to research and develop new infrastructure, including new transportation networks.

"It's far less complicated and cheaper than getting a robotic or an automated vehicle on the road."

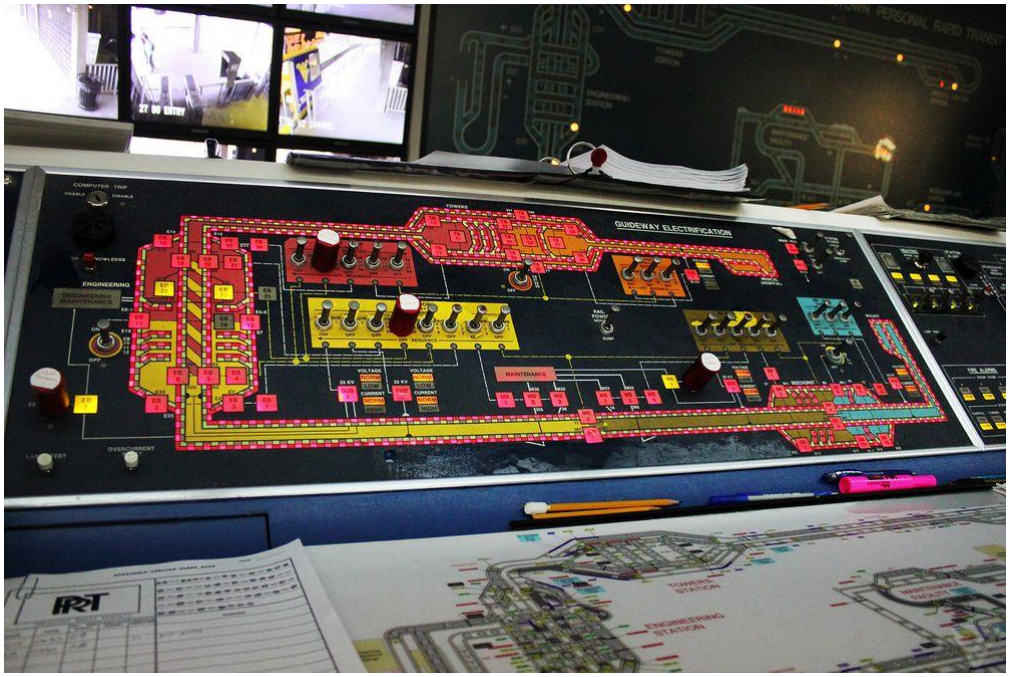
"One of the selling points of autonomous cars is that [they] would require minimal infrastructure changes. At most, what they might require is just a dedicated lane, which

doesn’t cost too much," says Pavone. "And this is in contrast to many of the ideas in the ‘60s, which were requiring massive public investments." The distinction, though, is fuzzier than it first appears. Today, the big question isn’t *whether* PRT will ever exist, but where it will exist — and how it will intersect with the world of self-driving cars.

In the early 2000s, a UK-based inventor developed a PRT concept he referred to as "urban light transport." After seeing a test track, Heathrow Airport bought a share in the "ULTra" system and announced that it would soon be using PRT to shuttle passengers around its terminals. Heathrow launched its 2.4-mile ULTra track in 2011, running 21 four-person pods between three stations along a terminal and nearby car park. An expanded track is under consideration, as are systems in two cities in India.

Airports are a friendlier environment for automated transit than cities ever were: passengers need only a few stops, all in a closed and mostly artificial environment free of homes, businesses, highways, or pedestrians. Still, there’s a chance of making the leap between the two. While guideway systems might be politically difficult to build, they’re a well-understood technology, especially compared to fully autonomous vehicles that can navigate traffic signs, pedestrians, and human-piloted cars. "It’s far less complicated and cheaper than getting a robotic or an automated vehicle on the road," says Burke. Unlike PRT, self-driving cars aren’t inherently *electric* cars, so environmental friendliness isn’t a given. And it may be a long time until cities think they’re worth the expense. "Even a Tesla, which has quite incredible software, costs over $100,000. Most of the people who use public transit are among the lowest income in the community," says Burke. "If it comes about, it will be for the wealthy, not the poor."

Back at WVU, Clement Solomon protests the notion that self-driving cars could replace PRT. Self-driving vehicles, he points out, wouldn’t have taken cars off Morgantown’s crowded roads — at least, not in the same volume. As long as they’re intermingled with human-driven cars, they can’t run with the same centralized efficiency. And once you start thinking about the obvious solution — a dedicated lane for self-driving cars — you might start running into the same problems as PRT. As Burke puts it, "there’s just no room for more roads."



The Morgantown PRT's control panel.

Solomon says that behind the scenes, outside interest in Morgantown's system is high. "There are many universities that are chatting with me right now," he says. He doesn't give names, but planners in the college town of Ithaca, NY have pushed for a "pod car" network in recent years, and a number of other cities — including Arlington, VA and San Jose, CA — have recently considered PRT as well. On the production side, companies like ULTra and Taxi 20004 have ready-to-build systems for sale. Burke works on the Advanced Transit Association's California Infrastructure Institute, a nonprofit dedicated to researching and lobbying for full-scale PRT networks in the state. She says they've gotten half a dozen cities seriously weighing an installation.

Why haven't plans like this come to fruition? "It's just the fear of the unknown," Solomon laments. And Morgantown's construction problems may still not be forgotten. "It turned out wonderfully," says Burke of the network. "But if you mention it to transit people — that came up probably within the last few years — they said, 'Oh, that was a complete mess, it totally failed.' That smell still hangs in the air."

In the long term, self-driving cars and PRT could merge — in ways that are strangely reminiscent of the StaRRcar. Kornhauser, who has run extensive feasibility studies of PRT in New Jersey, could see a future where dedicated HOV-like lanes run alongside the major arteries of seriously congested areas like Google's own home turf, Mountain View — covering maybe 80 percent of the average trip across the city. But at the very start and end, the self-driving cars would veer off into mixed traffic, delivering riders straight to their destination.

You could practically rewrite *Popular Science's* Urbmobile article for the concept — instead of twirling a dial, you'd enter an address; instead of sitting back and scanning the newspaper, you'd pick up a Kindle or iPad and begin your morning commute. Car

companies are again having to think about how to occupy passengers when they're no longer driving. And as in the '60s, we're talking about whether self-driving vehicles could spell the end of private cars.

Alden, now 89 years old, doesn't plan on resurrecting the original StaRRcar any time soon. But when Heathrow's PRT started to take shape in the mid-2000s, a former employee gave him a call. "Bill, you ought to get back in the business," Alden recalls him saying. "It's going to start going again." After decades away from PRT, he reunited with a group of other transportation experts to build a new system called Airport Personal Transport, a tiny self-driving car network that would run in Boston's Logan Airport. The system would be comprised of two-passenger carts that travelers could call up and ride the same way they would a PRT. But vitally, it wouldn't require any new tracks or guideways — something Alden says would have been a dealbreaker for Logan. The company launched a Kickstarter for the project in early 2015, but it proved ill-suited to crowdfunding. Alden is now looking at more traditional investment, banking on still-active interest from Logan.

The future that actually happens, though, will never feel quite as futuristic as the one that gets frozen in time. Our self-driving cars will still feel like ordinary cars, even if they can do things that we once thought impossible. And the StaRRcar and Urbmobile, which modern users would probably find antiquated or outright unusable, still have the sheen of science fiction.

Today, the same white bullet that Walter Cronkite rode in 1966 sits in a garage in Vermont, its test track long since demolished. Along with a handful of aging closed-loop test cars sitting on a friend's New Hampshire property, it's the last fragment of an idea whose legacy would prove more complicated than its creators could possibly have imagined. And aside from a bout of vandalism, it's weathered the years well. "It's a little dusty," says Alden, "but it's there."

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Original photography and illustration by James Bareham

Additional photography by Adi Robertson

StaRRcar footage courtesy of William Alden

Edited by Chris Ziegler

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https://www.theverge.com/2016/2/24/11094524/prt-transit-history-self-driving-cars-alden-starrcar-tomorrowland-1960s

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Photo Essay

West Virginia’s retro-futuristic pod car network in photos

Personal rapid transit lives on

By Adi Robertson -- Feb 24, 2016

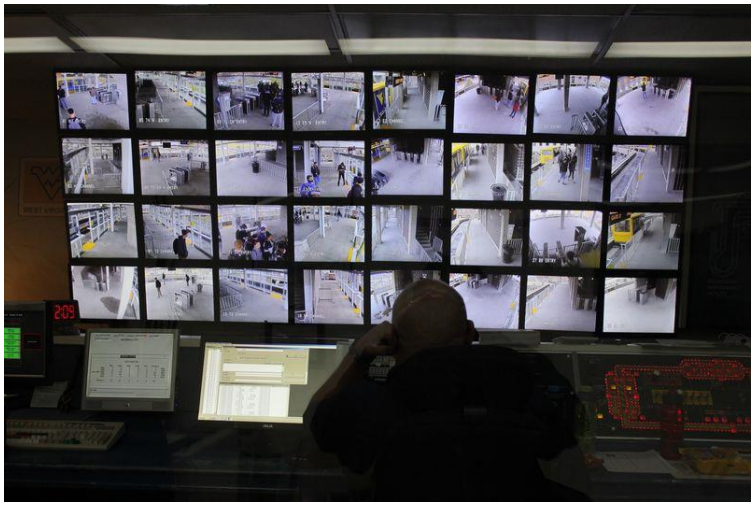
Personal rapid transit — a mass transportation network that could carry passengers straight to their destinations in small private cars — has a long, fascinating, and often troubled history. But the first (and so far, only) PRT project in America has been running almost continuously in West Virginia since 1975.

Last month, I visited the city of Morgantown to check out West Virginia University's PRT, a five-station network that connects the school's three campuses. The system, which uses small cars rolling on electrified guideways, was built to lessen the strain on Morgantown's crowded roads as the university expanded. Today, students and faculty get a free pass, and everyone else pays fifty cents a ride.

I started looking at the WVU network while researching the Urbmobile, a '60s PRT prototype that was featured in *Popular Science* and *Life* magazine. But it's worth checking out in its own right, too — so here are a few of the photos I took during my trip.


ENTER
TOWERS
DORMITORIES
SELECT STATION
press button to unlock gate
INVALID FARE
add coins or re-swipe card


Morgantown
Personal Rapid Transit



https://www.theverge.com/2016/2/24/11107760/morgantown-west-virginia-university-personal-rapid-transit

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Joe's Big Idea

Joe Palca

Why Nonstop Travel In Personal Pods Has Yet To Take Off

September 24, 2015 Heard on Morning Edition

Credit: Ackerman + Gruber for NPR

The average American commuter spends 42 hours per year stuck in rush-hour traffic, according to one recent study.

More than four decades ago, West Virginia University thought it had found a solution to urban traffic woes: It built a transportation system known as personal rapid transit, or PRT.

Instead of riding with dozens of others on a train car or bus, PRT pods carry a small number of people. And instead of making stops, PRT takes you directly to your destination, nonstop.

To its supporters PRT makes total sense, yet there are only a handful of PRT systems in operation around the world.

To find out more about whatever happened to PRT, I recently traveled to Minneapolis to meet Mike Lester, CEO of Taxi 2000, a company that designs PRT systems.

Taxi 2000 is a Minneapolis firm developing the SkyWeb Express system, a point-to-point personal rapid transit system. Here, company CEO Mike Lester works in the company's warehouse in Fridley, Minn. Ackerman + Gruber for NPR

Lester's PRT system is called SkyWeb Express. He has built the software for it and a prototype of the pod it would use, and he has engineering drawings for the rest of the system. All he needs is a customer.

He takes me over to a large table where he has set up what looks like a slot car race track, which he tells me is about a 1/15th scale model. It simulates how a real system would work, including communication with a central computer that keeps track of imaginary passengers who want rides.

Lester takes several small cars and places them on the track.

Credit: Ackerman + Gruber for NPR

Most of the time they whiz around the track, but occasionally one pulls off into a siding.

"That's on off-line station," Lester explains. "The computer said there's a passenger over there, you need to go get him. So the control system just sent the car over there."

PRT systems have lots of advantages over current transit systems, Lester says.

The pods that carry passengers are "on demand," meaning you only move a car when it's needed — no empty buses following a set schedule.

To use SkyWeb Express, the passenger would swipe a fare card and enter the destination station code on the boarding station before entering the car. Ackerman + Gruber for NPR

And because the PRT vehicles are lightweight, you don't need tunnels, track beds or other expensive infrastructure. Skyweb Express runs on an elevated guideway held up by nothing more than stanchions about the size of lampposts.

There are two more good reasons to make an elevated PRT system, Lester says: safety and speed.

"The automated vehicle is not interacting with pedestrians, bicycles, buses and not-automated vehicles," he says — and that avoids accidents and prevents traffic-related stops.

Lester is eager for me to take a ride in the full-sized prototype of his PRT pod. He hands me a laminated card with a magnetic strip on it: a Skyweb Express fare card.

He leads me over to a set of stairs that goes up to a small platform. In a real system, I'd insert the fare card into a display, punch in the station and instructions for the pod would be coded on the card's magnetic strip.

Waiting at the platform is a tiny, bright red, pod-like car. There's a bench that can fit three passengers. Lester tells me to swipe my card in a card reader next to the pod. When I do, the pod's door opens. I get in and sit down.

There's a button over the front window that says "go" on it. When I push it, the door slides shut and latches. The pod glides soundlessly down a track that's about 60 feet long. When we reach the end, the car stops, and the door slides open.

To be honest, I think riding to work in one of these automated pod cars would be kind of fun.

So why has PRT failed to catch on? Ken Halverson, chief financial officer for Taxi 2000, says the company's potential customers are playing a game of chicken.

"We've had 40 or 50 cities tell us they would love to be second," says Halverson. "But you can't be second until someone steps up to be first."

Halverson says Greenville, S.C., is seriously considering going first, but so far hasn't signed on the dotted line.

Taxi 2000 is headquartered in Minneapolis, so I speak with Tom Sorrel, a former Minnesota commissioner of transportation, to find out why that city doesn't have a personal rapid transit system.

He says the state considered PRT, but there was stiff opposition from backers of buses and light rail, and nothing was ever built.

The light rail runs through downtown Minneapolis in September. Ackerman + Gruber for NPR

"I think one of the challenges we've always had with PRT is there's no pot of money where this fits well," he says. "And that's just not Minnesota, it's nationally as well."

In contrast, tax money is already allocated for things like buses and light rail.

The other problem facing PRT is that the picture of urban transit is changing: Uber and similar services already exist, and driverless cars don't appear to be far off. Sorel wonders if PRT's time has come and gone.

"The last thing you want to do is put up some track all over the place and have it just there," he says.

But there are still many, including Sorel, who believe PRT is still a viable option. The system in at West Virginia University is still running, and people there are spending money to modernize it.

But the West Virginia system, built in 1975, has not yet kickstarted a revolution in rapid transit, as its creators and backers had hoped.

https://www.npr.org/2015/09/24/440859459/why-nonstop-travel-in-personal-pods-has-yet-to-take-off

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