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Automated Transit Applications

Real-World Examples

RONGFANG LIU

The author is Professor, Department of Civil and Environmental Engineering, New Jersey Institute of Technology, Newark.

JFK Airport's AirTrain. Established, real-world automated transit technology may provide insight into the development of automated vehicles.

The rapid development of driverless cars by Google and others not only grabbed the attention of the general public, researchers, and government agencies, it also created the opportunity for a thorough examination of automated transit applications and their impact on and implications for society. According to Steven Shladover, a leader in autonomous vehicle research,

> "Some of the strongest progress in vehicle automation has already been made in the field of transit. Indeed, one could consider the wide variety of airport people movers and automated urban metros to be examples of existing deployed automated vehicles, except these are mechanically captive to their guideways" (*1*).

Automated transit comes in a variety of applications, both top- and bottom-supported (*2*). Some systems roll on rubber tires, some are pneumatically levitated, some are propelled with rotary electric motors, and some are cable-drawn. Many real-world applications—based on driverless metro (DLM), automated people mover (APM), and personal rapid transit (PRT) technologies in various planning, construction, and operation stages—may serve as theoretical and practical laboratories to examine various aspects of automated transit technologies and their successes and failures in meeting the travel needs of various markets.

According to a recent tally, more than 100 applications along the continuous spectrum of automated guideway transit (AGT) technologies can be seen

Paris Métro's Line 14 is completely automated.

PHOTO: PLINE, WIKIMEDIA

around the world (*3*). After more than four decades, AGT technology is no longer limited to airport use as shuttles or circulators but has expanded to downtown and metropolitan areas, as major activity-center circulators and public transit systems.

For detailed definitions of various automated transit applications and their respective characteristics, see the author's *Automated Transit: Planning, Operation, and Applications* (*4*). An excerpt from Chapter 4 of the book is included below to highlight a few case studies, from high- to medium- to low-vehicle capacity systems.

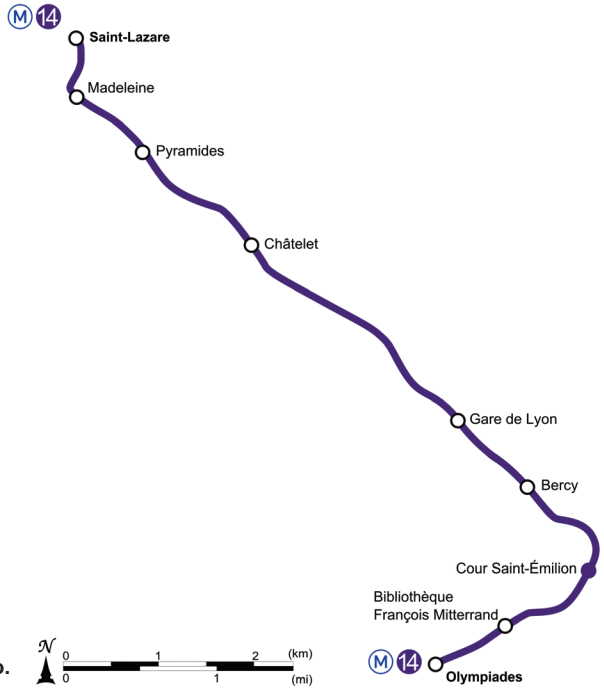

FIGURE 1 Route Map for Line 14, Paris Métro. (Source: M0tty, 2015.)

Driverless Metro in Paris

The Eiffel Tower is a symbol of Parisians' embrace of technology and innovation in the 19th century. The implementation of DLM in Paris in the late 20th century once again showed the French determination to lead in technology and innovation.

In 1987, the Regie Autonome des Transports Parisiens proposed "Project Météor" to create a new Métro Line 14 from Porte Maillot in the northwest of Paris to the Maison Blanche district in the southeast—an area that is poorly served by public transport despite its large population. To simplify its complicated operation, the line was modified later to originate from Saint-Lazare with the possibility of extension to Clichy and assimilation of the Asnières branch of Métro Line 13 (see Figure 1, at left).

Paris Métro Line 14 incorporated innovations that served as testing labs for the rest of the network—for example, the 120-m-long stations are larger and longer than old stations and thus can accommodate eight-car trains. Stations are more spaced out as well, allowing an average speed of nearly 40 km/h—close to double that of the other lines.

Photo: Erwin Soo, Flickr

A double-loop track surrounds Bukit Panjang, serving 14 stations and approximately 3 million people annually.

Most importantly, the line is completely automated and runs without any drivers. This was a first for Paris Métro as well as for a major metropolitan line in a national capital city.

Automated Light Rail Transit in Singapore

Amalgamating the advantages of Métro, light rail transit (LRT), and APM, a series of automated light rail transit (ALRT) applications have been implemented in various locations around the world. ALRT combines proven technology with two significant innovations: linear motors and steerable axle bogies, which together offer central control, minimize noise, and reduce wear and tear on rails laid to the standard gauge (5).

The Bukit Panjang ALRT line opened in Singapore in November 1999. As a feeder to mass rapid transit and bus services, the 7.8-km Bukit Panjang line plays a significant role in accomplishing Singapore's national transit access goal to establish public transportation access within a quarter-mile (400-m) walk of every citizen in the country (6). The Bukit Panjang line connects to the mass rapid transit line at Choa Chu Kang Station and loops around Bukit Panjang ("Long Hill"), a new town with more than 139,000 residents (7). The Bukit Panjang line is a critical element that makes the new town accessible and desirable as a residential location.

The Bukit Panjang line operates from 5:00 a.m. to 1:00 a.m. along a double-track loop with 14 stations. The headway is approximately 2–4 minutes for rush hour and 6 minutes for the rest of the day. Nineteen rubber-tired vehicles transported 10,000 peak-hour riders in 2015, translating to an approximate annual ridership of more than 3 million assuming an average peak-period loading of 10 percent of daily traffic.

The average speed of the Bukit Panjang ALRT line is about 25 km/h; it takes approximately 28 minutes to traverse the entire line. The cars have a capacity of 105 passengers—20 sitting and 85 standing.

Detroit Downtown People Mover

Unlike transit-scale applications of automated transit technology, which usually have fixed routes and schedules and charge transit fare, APMs generally serve as circulators or connectors to main transit,

Photo: Calvin Teo, Wikimedia

Automated light rail in Bukit Panjang, Singapore, provides transit access to more than 139,000 city residents.

PHOTO: MR. GRANGER, WIKIMEDIA

Detroit People Mover's Millender Center station is integrated into a building that houses a major hotel and residential apartments.

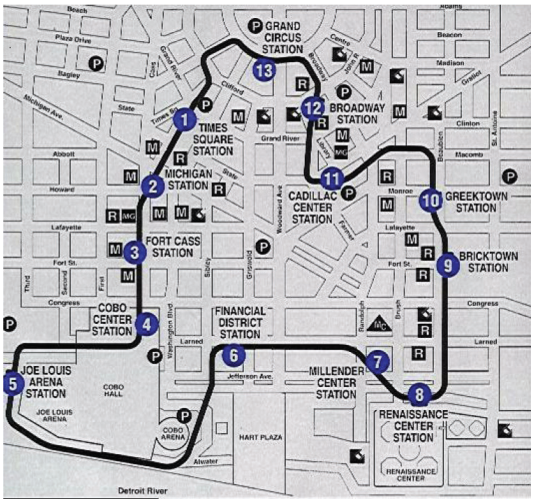

FIGURE 2 Detroit People Mover.

highway, or activity centers. Examples include downtown, airport, and major activity center circulators, or shuttles between two or more interesting points that may or may not require a fare. APM systems usually use intermediate-capacity vehicles—smaller than DLM trains and larger than PRT pod cars.

A product of the Downtown People Mover Program, or DPM, enacted by the U.S. federal government in the 1970s, the Detroit People Mover—one of three downtown people mover applications in America—opened its service in 1987. The fully automated guideway transit system operates on an elevated guideway that is 2.9-mile single-track loop, as shown in Figure 2 (above).

The Detroit People Mover connects 13 stations through the central business district of Detroit, with two-car trains running on an elevated one-way loop (*8*). Two of these stations, Millender Center and Cobo Hall, are integrated into buildings. The trains run every 3–5 minutes throughout the day between 6:30 a.m. and 2:00 a.m. on weekdays and for a shorter period on weekends (*9*).

The initial capital cost of the Detroit People Mover was $200 million and it requires $10 million per year to operate (*8*). The 75-cent fare (discounted 50 percent for seniors and riders with disabilities) covers only 15 percent of the operating expenses. The City of Detroit supplies the rest of the funds—$8.5 million per year.

PHOTO: JAVIER RAPAPORT, FLICKR

The Detroit People Mover. Smaller, automated transit vehicles connect travelers to main transit, highway, or activity centers.

PHOTO: PIXABAY

JFK Airport's AirTrain combines APM technology with urban metropolitan applications.

AirTrain at JFK Airport

The AirTrain at John F. Kennedy (JFK) International Airport in New York is included in this article because of its unique combination of airport APM and urban metro in one AGT technology application. AirTrain connects JFK International Airport—the busiest international air passenger gateway to the United States (*10*)—to nearby destinations in New York City and New Jersey. The 8.1-mile-long APM, which cost $1.9 billion to build, began construction in 1998 and opened in December 2003. Its 10-station, 1.8-mile airport circulator loop and two extensions to urban transit systems equal 6.3 miles.

AirTrain uses AGT technology from Bombardier. The capacity of the system's trains ranges from one to four cars at 75–78 passengers per car. Train headway is approximately 10 minutes, taking about 2 minutes between terminals. AirTrain serves three main routes: All Terminals Route, Howard Beach Route, and Jamaica Station Route. As shown in Figure 3 (at right), the All Terminals Route is a circular route that connects all six terminal stations. The Howard Beach and Jamaica Station routes connect the terminals with regional mass-transit hubs, such as the New York subway and the Long Island Railroad (LIRR).

The initial goal of AirTrain was to provide air passengers and airport employees with rail access to JFK International Airport from the Howard Beach and Jamaica stations (*11*). When the APM was linked to a broader vision for the redevelopment of the Jamaica area and the larger Queens borough, an automated transit application was born.

As one of the nation's busiest transit hubs, Jamaica Station serves more than a quarter of a million commuters daily via three subway lines, 31 bus lines, and LIRR commuter rail lines. Shortly after the construction of AirTrain, the renovation of Jamaica station took place. This ushered in a series of infrastructure improvement projects, as well as economic development in the immediate surrounding areas. For example, JFK Corporate Square—a 300,000-sf office complex in downtown

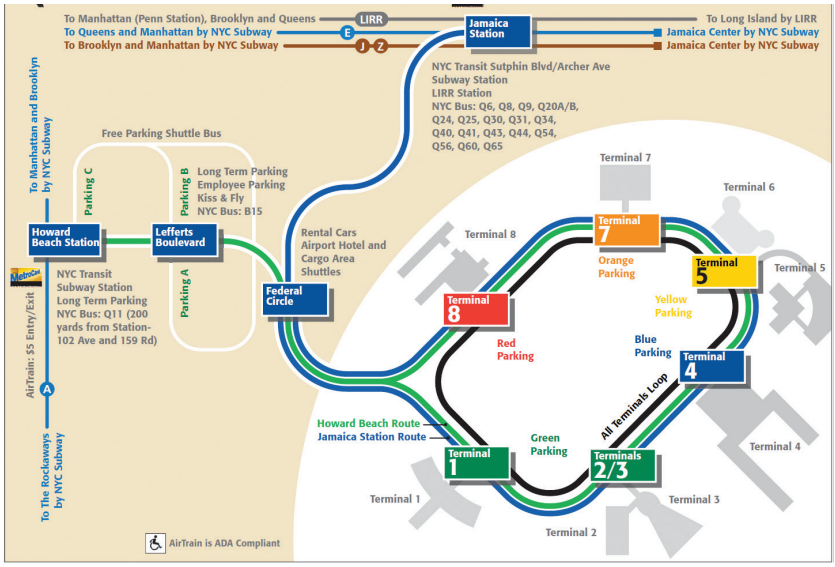

FIGURE 3 AirTrain at JFK International Airport. (Source: Port Authority of New York and New Jersey, 2005.)

New York's Jamaica Station serves as a hub for subway, bus, commuter rail, and AirTrain.

Photo: Travis Wise, Wikimedia

Jamaica—welcomed its first tenants in 2001 (*12*). In turn, further improvements to AirTrain have been included in multimillion-dollar joint capital projects by New York City and the Port Authority of New York and New Jersey.

Morgantown Group Rapid Transit

The Morgantown Personal Rapid Transit System is an automated tri-mode transit system—demand, schedule, and circulation—in northeastern West Virginia. The Morgantown people mover should be classified as group rapid transit because of its intermediate vehicle size and capacity. Each vehicle has a capacity of 21 passengers—eight seated and the rest standing. The system's operating characteristics are closely tied to PRT when it is on demand mode; that is, direct from origin to destination station.

The Morgantown Personal Rapid Transit System features a multiberth, bypassing-station layout. Each station is composed of off-line channels for vehicle berthing, a key feature that affords direct operation between origin and destination stations.

Ultra PRT at Heathrow International Airport

Although the concept has been around for more than a half a century, a true PRT application largely has not materialized, with only three limited PRT applications around world as of early 2018. These applications, with their small guideway footprints and small, four- to six-person vehicles, are located in Heathrow International Airport, London; Masdar City, Abu Dhabi; and Suncheon Bay, South Korea.

After starting on a small, testing scale, the initial Ultra PRT system at Heathrow International Airport has a 3.8-km (2.4-mi) double guideway that connects three stations—two in the Terminal 5 business car park and one at Terminal 5 itself, as shown below. The Ultra PRT fleet comprises 21 vehicles, or "pods," and total travel time between the two terminals is about 5 minutes.

As of May 2013, Ultra PRT's second anniversary of full operation, the pods collectively had operated for more than 26,000 vehicle hours, transported more than 1.2 million passengers, and traveled more than 2.5 million vehicle-km (*13*). Encouraged by positive experiences from operators and passengers,

Ultra PRT at Heathrow International Airport.

Photo: Ultra Global Limited 2013

Photo: Brian M. Powell, Wikimedia

The Morgantown Personal Rapid Transit System has size and capacity of a rapid transit vehicle.

Heathrow Airport Holdings Limited is considering the expansion of the Ultra system (*13*).

Conclusion

Automated transit applications come in many forms that may be called different names depending on their configuration, operating environment, and service characteristics. A common thread connecting these members of the AGT family is operation via central control systems without onboard human drivers—similar to automated roadway vehicles. Unlike automated buses and automated roadway vehicles, however, many of which are still in various developing and testing stages, each form of AGT has one or more applications in real-world operation.

Building on the extensive research conducted over more than half a century and expansive communications with a large network of professionals, *Automated Transit: Planning, Operation, and Applications* presents a comprehensive review of automated transit technology and its applications and offers some lessons for the ongoing development of automated vehicles.

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