WHAT'S IN THE PIPELINE?

A Preface to ASCE APM 05 Conference and Proceedings

Hal Lindsey

Business Development Manager, East Coast Region; Lea+Elliott, Inc., 14325 Willard Road, Suite 200, Chantilly, Virginia 20151-2110; PH: (703) 968-7883; FAX: (703) 968-7883; email: hlindsey@leaelliott.com

INTRODUCTION

This paper serves both as a point of continuity - looking at what has happened in the driverless transit industry since the last conference in Singapore in 2003 - and as a point of reference - looking forward at what is in the pipeline. Suffice it to say, our industry is healthy and robust, despite continuing challenges with the world economy, world peace, air carriers and their re-definition, terrorism concerns and the corresponding need for increased security, and the like. This paper specifically surveys and lists driverless transit systems in the airport and urban sectors that have been opened since 2003 and those that are currently under construction. There are many more that are in the planning or procurement phase, or are being refurbished, that are not addressed in detail in this paper.

EXPANDING MARKET

The traditional focus of the ASCE APM Meetings for the last two-plus decades has been the AGT (automated guideway transit) industry. In the early beginnings of the AGT industry (in the late 1960s and the early 1970s), AGT systems were implemented at airports to provide reliable, horizontal elevator service on a frequent basis between landside terminals and remote, airside concourses. They were also implemented in a couple of urban environments, including West Virginia University at Morgantown (the first true Personal Rapid Transit (PRT) system, opened in 1975) and Las Colinas (a suburb of Dallas/Ft. Worth).

The federal government provided subsidies for Morgantown and then to a much greater degree for the downtown people mover demonstration program that built the systems in Miami, Detroit and Jacksonville, that opened in 1986, 1987 and 1989, respectively. Close on the heels of these openings, driverless rapid transit systems (regional-sized line haul systems, not activity center circulators) were planned, funded and procured (but not implemented due to political issues) in Houston and Honolulu.

In North America, the only driverless rapid transit systems of a regional dimension are in Vancouver – 2 lines so far, with a third line recently committed. While the North American market for driverless rapid transit systems has been Spartan, this has not been the case in Europe and Asia. Not only are many new rapid

transit systems being built in a fully driverless mode, but also many older systems are being modernized.

This modernization typically converts a manually driven system to true driverless operation, thus increasing the number, scope and breadth of what was formerly known as AGT. Given the growth of these systems, and public transit authority reluctance to call these systems AGT, this author simply calls these systems driverless (see definitions in the next section of this paper). The heart and soul of any driverless transit system - its automatic train control system - is the primary (but not only) point of commonality that relates all driverless systems together. The only difference then between small circulator systems and large rapid transit systems is size and function.

The growth and popularity of driverless rapid transit systems in essence proves that AGT Systems have come in to the mainstream of public transit use, the theme of the ASCE APM 05 Conference, and a new hallmark in our industry. Given that, this paper divides the market into two distinct segments: Airports and Urban (Non-Airport).

DEFINING TERMS

Many have used the phrases AGT and APM (automated people mover) interchangeably. Now we have driverless rapid transit systems. Are they AGT as well? Here are a few thoughts.

"AGT" is synonymous with "driverless transit" and is the large umbrella under which all truly driverless transit technologies fall. AGT means no driver, no attendant.

"APM" implies a smaller-scale AGT system that serves as a circulator within an activity center (like a downtown or hospital campus). APM systems are often linked to larger, line haul systems that carry people from one activity center to another. APM systems expand the reach of line haul transit systems, as do buses, moving and pedestrian walkways, and other means of conveyance.

"Driverless Rapid Transit" is a regionally sized, line haul system that is truly driverless (see definition of AGT above).

"Monorail" evokes a popular image with the public and is often used as another name for AGT. In fact, if a monorail system is driverless, it is a subset of AGT. Saddleback monorail systems have vehicles that ride on top of a single guidebeam while suspended monorail systems have vehicles that hang below the guidebeam.

"PRT"(Personal Rapid Transit) implies small vehicles operating on short headways with off-line stations and on-demand service. The PRT system at Morgantown has off-line stations and on-demand service, but larger vehicles and longer headways than the more contemporary definition of PRT.

"GRT" (Group Rapid Transit) has historically meant larger vehicles that operate on a fixed route where the vehicles stop at every station.

AIRPORT SYSTEMS

A quick snapshot of the airport industry and its driverless transit systems identifies 16 projects worldwide that were opened since the last ASCE APM conference in 2003 or are currently in construction. The following observations can be made based on Table1 on the next page:

- Over one-third of the airports are building landside systems while the rest are airside. Most are aware that the driverless transit industry began at airports some 34 years ago to serve a predominantly airside function, linking one or more airside concourses with the main terminal. This ratio of landside to airside systems is expected to continue into the future.
- Of the 16 airports, 6 are buying from Bombardier, 5 from Mitsubishi, 2 from Doppelmayr and one each from Siemens and Poma-Otis. The apparent low bidder in Atlanta for the new landside system includes Mitsubishi, which would give them even billing with Bombardier for new airport systems. Mitsubishi has made significant in-roads to the marketplace that was started and monopolized for many years by Westinghouse Electric/AEG/Adtranz (now owned by Bombardier).
- Poma Otis, with only one system on the list that opened in 2004, has nothing else in the pipeline. Doppelmayr is continuing to pursue this marketplace with great interest.
- Major players in the transit industry, and highly active in the Urban Systems table (namely Alstom, Siemens and Ansaldo), continue to be absent from or rarely competing in the airport marketplace.
- One-fourth of the airports purchased a radio-based automatic train control system with its inherent advantages of shorter headways and less wayside hardware. While not cost-effective for simple shuttle systems, this trend is expected to continue for pinched-loop systems.

Airports Moving Towards Construction

Airports to watch in the near term (who are currently in the planning or procurement phases) include Los Angeles, Sacramento, Las Vegas (T3), Phoenix, Orlando (South Terminal), and Miami (MIA Mover) and Beijing. In the Personal Rapid Transit marketplace (a subset of the greater AGT/driverless transit industry), procurement is currently in process at London Heathrow (for a landside system). There is similar interest at Houston's George Bush Intercontinental Airport to replace the underground WEDway PeopleMover System.

Refurbishments

Many of the early airport people mover systems have undergone refurbishment and this cycle is expected to continue as 20+-year-old systems are either replaced or refurbished. As in the case at Seattle-Tacoma, modernization included the upgrading of the system’s ATC for increased reliability and throughput. Sea-Tac’s program is nearly complete. Others currently in process include Atlanta, London Gatwick, and Orlando.

City/Airport	Country	Airside/ Landside	Dual Lane Track Length (miles)	Number of Vehicles	Stations	Vehicle		ATC		Peak Hour Capacity (pphpd)	Procurement Method	Date Opened or Projected
						Supplier	Model	Supplier	Technology			
Birmingham	United Kingdom	Landside	0.4	4 (2x2)	2	Doppelmayr	CableLiner	Siemens	S7400 Fixed Block	1,600	System DBOM	2003
San Francisco	United States	Landside	3.0	38	9	Bombardier	CX-100	Bombardier	CITYFLO 650 CBTC (formerly "Flexiblok")	3,400	System DBOM	2003
Minneapolis - St. Paul	United States	Airside (Concourse C)	0.6 (single lane with bypass)	4 (2x2)	3	Poma Otis	203 (30')	GE	PLC-based moving block with fixed block overlay	1,800	System DBOM	2004
Dallas - Ft. Worth	United States	Airside	5.0	64 (32x2)	10	Bombardier	Innovia	Bombardier	CITYFLO 650 CBTC	5,000 Initial 8,500 Ultimate	System DBOM	2005
Houston (George Bush)	United States	Airside	0.9	12 (6x2)	3	Bombardier	CX-100	Bombardier	CITYFLO 550 (formerly "Geoloc")	4,800	System DBOM	2005
Tampa	United States	Airside (Airside C)	0.2	4 (2x2)	2	Bombardier	CX-100	Bombardier	Fixed Block	4,000	DBOM	2005
Madrid	Spain	Airside	1.7	19 (6x3 plus spare)	2	Bombardier	CX-100	Bombardier	CITYFLO 550	6,500	System DBOM	2005
Toronto	Canada	Landside	0.9	12 (2x6)	3	Doppelmayr	CableLiner	Siemens	S7400 Fixed Block	2,150	System DBOM	2005/2006
Paris (Charles de Galle)	France	Landside Line 1	2.2	14 (7x2)	5	Siemens	VAL 208	Siemens	Not Avail.	1,900	System DBOM	2006
		Landside Line 3	0.4	6 (3x2)	2	Siemens	VAL 208	Siemens	Not Avail.	Not Avail.	System DBOM	2006
Miami	United States	Airside (North Terminal)	0.8	20 (5x4)	4	Mitsubishi	Crystal Mover	Kyosan	Fixed Block	4,500 (sterile) & 4,500 (non-sterile)	System DBOM	2007
Singapore	Singapore	Both 4 single-lane shuttles, 2 synch'd bypass shuttles and 1 synchronized double shuttle	0.9 dual; 1.1 single	16 Initial; 29 Ultimate	7	Mitsubishi	Crystal Mover	Kyosan	Fixed Block	Varies; Busiest Shuttle Initially is 2,069; Ulimate Busiest is 3,104	System DBOM	2007
Atlanta*	United States	Landside (CONRAC)	1.4	TBD	3	TBD	TBD	TBD	TBD	5,100	DBOM	2008
London (Heathrow)	United Kingdom	Airside (T5)	0.3	6 (2x3)	2	Bombardier	Innovia	Bombardier	CITYFLO 650 CBTC	6,400 Initial; 7,000 Ultimate	System DBOM	2008
Washington, DC (Dulles)	United States	Airside	2.1 Initial; 4.2 Ultimate	29	4 Initial	Mitsubishi	Crystal Mover	Alcatel	SelTrac S40	6,550 Initial; 8,950 Ultimate	System DBOM	2008
Seoul (Incheon)	South Korea	Airside	0.6	9 (3x3)	2	Mitsubishi	Crystal Mover	TBD	TBD	5,340 Initial	System DBOM	2008
Dubai	United Arab Emirates	2 Airside Systems	Each 0.6	18 (2x5 and 2x4)	2 Each	Mitsubishi	Crystal Mover	TBD	TBD	6,300 and 4,500	System DBOM	2008

*Not under contract as of 2/1/05

Table 1. Airport Systems

System Extensions and New Fleet

Several airport systems are planning extensions or new lines. These include Chicago O'Hare, Atlanta, and Frankfurt. Others have purchased or plan to purchase new vehicles to add capacity to their current system or support system extensions. These include Hong Kong, Chicago O'Hare and Atlanta.

URBAN SYSTEMS

In our survey, there are more driverless transit system projects sponsored by public transit authorities (plus a few private sector owners) than by airports. While most are new lines, there are an increasing number of older rapid transit lines that are "modernizing", that is upgrading one or more subsystems that include the automatic train control system. Among others, reasons for these upgrades include desire for shorter headways and higher throughput, replacement of obsolescent and increasingly unreliable hardware, desire to minimize labor costs and increased system safety. Reviewing Table 2 on the next page, the following observations can be made:

- A wide diversity of Vehicle suppliers are represented in this market segment, led by Bombardier with 4 systems, Alstom and Siemens with 3 each and Mitsubishi with 2.
- Siemens is the clear leader among the automatic train control subsystem suppliers with 6 of the 16 systems that have been named. Alcatel, Alstom, Bombardier and Kyosan have 2 each.
- Half of the eighteen systems have chosen some form of communications-based train control.
- About half of the systems are rubber-tired and the rest are steel-wheeled.
- There are more rapid transit line modernizations than ever before. This trend is expected to continue as older systems are modernized and operating subsidies are optimized.
- The United States is still lagging behind in terms of applying driverless train control technology to rapid transit systems. New York City Transit and Bay Area Rapid Transit are making steady headway in this area but it remains to be seen if either will commit to true driverless operation. Other large transit authorities are likely to follow suit over this decade, following successful modernizations in one or both of those cities.

Urban Systems Moving Towards Construction

Keep an eye on a large driverless rapid transit system in Dubai, the BART-Oakland Airport Connector in San Francisco and a Circle Line in Copenhagen.

Refurbishments

Like in the airport segment, many of the older driverless systems have undergone refurbishment. These include the Detroit and Miami Downtown People Mover Systems (the original Jacksonville DPM was replaced). Watch for more refurbishment and replacement work as time marches on and miles are logged.

City	Country	System	Dual Lane Track Length	Number of Vehicles	Stations	Vehicle		ATC		Peak Hour Capacity	Procurement Method	Date Opened or Projected
						Supplier	Model	Supplier	Technology			
Singapore	Singapore	North East Line	12.4	150 (25x6)	16	Alstom	Metropolis	Alstom	URBALIS 300 Moving Block	42,000	Conventional	2003
Singapore	Singapore	Sengkang Line	6.6	18	14	Mitsubishi	Crystal Mover	Kysoan	Fixed Block	2,100 Initial	System Turnkey	2003
Copenhagen	Denmark	Orestad Line Initial Phases	10.2	57 (19x3)	17	Ansaldo	Metro	Ansaldo	Fixed Block	12,000	System Turnkey	2002-2003
		Ultimate	13.0	102 (34x3)	22	Ansaldo	Metro	Ansaldo	Fixed Block	12,000	Same as Initial	2007
Indianapolis	United States	Clarian Hospital (Private)	1.4	6 (2x3)	2 Initial; 3 Ultimate	Schwager-Davis	Unitrak	PSI	Fixed Block	800	DBOM	2003
New York	United States	JFK AirTrain	8.0	32	10	Bombardier	Advanced Rapid Transit MK II	Alcatel	SelTrac S40	5,820 (could be doubled if lines not overlapping)	DBOM	2004
Las Vegas	United States	Phase 1 (Private)	4.0	36 (9x4)	7	Bombardier	M-VI Monorail	Alcatel	SelTrac S40	3200 to 8,000 (phased)	DBOM	2004
		Phase 2* (Public-Private)	2.5 additional	20 (5x4)	4	Bombardier	M-VI Monorail	Alcatel	SelTrac S40	TBD	DBOM	TBD
Torino	Italy	Line 1	5.6	92	16	Siemens	VAL 208	Siemens	Fixed Block	16,300	System Turnkey	2005
Singapore	Singapore	Punggol Line	7.3	23	19	Mitsubishi	Crystal Mover	Kysoan	Fixed Block	2,700 Initial	System Turnkey	2005
Barcelona	Spain	Line 9	25.0	250 (50x5)	43	Alstom	Metropolis	Siemens	Airlink CBTC	17,000 Ultimate	Conventional	2005-2008 (phased)
Nuremburg	Germany	Line U3 Modernization	7.2	60 (16x2 for Line U3; 14x2 for Line U2)	16	Siemens	Not Avail.	Siemens	Not Avail.	Not Avail.	Conventional	2006
Singapore	Singapore	Circle Line	20.6	120 (40x3)	29	Alstom	Metropolis	Alstom	URBALIS 300 Moving Block	24,000	Conventional	2007-2010 (phased)
Toulouse	France	Line B	9.9	94	20	Siemens	VAL 208	Siemens	Fixed Block	9,240	System Turnkey	2007
Paris	France	Lines 3,5,9,10 and 12 Modernization	44 (total all lines)	N/A	144 (total all lines)	N/A	N/A	Siemens	Airlink CBTC	varies from 2,000 to 27,000	Conventional	2007-2009 (phased)
Taipei	Taiwan	Neihu Line Ext., First Stage	6.0	60	12	Bombardier	TBD	Bombardier	CITYFLO 650 CBTC	TBD	Limited Turnkey	2007
		Including Second and Third Stages	9.0	202	Not Avail.	Bombardier	TBD	Bombardier	CITYFLO 650 CBTC	24,800	Limited Turnkey	2008
Yong-In	Republic of Korea	Rapid Transit Line	11.5	30	15	Bombardier	Advanced Rapid Transit	Bombardier	CITYFLO 650 CBTC	7,680 Initial 9,257 Ultimate	DBOM	2008
Budapest	Hungary	Metro Line M2 Modernization	6.0	N/A	11	N/A	N/A	Siemens	Airlink CBTC	Not Avail.	Conventional	2008
Vancouver*	Canada	Richmond-Airport-Vancouver (RAV) Line	12.1	TBD	18	TBD	TBD	TBD	TBD	TBD	DBOM	2009
Seattle*	United States	Green Line Monorail	14.0	TBD	19	TBD	TBD	TBD	TBD	2,000	DBOM	2009

*Awarded; not under contract as of 2/1/05

Table 2. Urban Systems

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