A Hierarchical Typology of Intermodal Air-Rail Connections at Large Airports in the United States

Andrew R Goetz

Department of Geography

University of Denver

Timothy M Vowles

Department of Geography

University of Northern Colorado

Introduction

In July 2005, the United States Government Accountability Office (GAO) issued a report discussing intermodal transportation strategies in developing airport intermodal capabilities (USGAO 2005). In this report, the GAO identified those airports that had a direct rail or bus connection, to either nationwide or local systems, among the largest 72 US airports. GAO found 13 airports directly connected to nationwide rail (the Amtrak system), and 27 airports directly connected to local or regional rail systems (see Figure 1). The GAO "considered a direct connection to consist of a transfer point (such as a bus stop or rail station) that is accessible from airport terminals either by walking, an automated people mover, or direct shuttle" (USGAO 2005, p. 7).

Unfortunately, the GAO definition of a "direct" intermodal connection did not distinguish among numerous important characteristics that define the quality of an intermodal air-rail linkage. For example, there is a huge difference between service provided at an on-airport rail station that is accessible by walking as opposed to having to take a shuttle to an off-airport rail station. There are differences in the type and length of shuttle services between airports and rail stations. Likewise, rail

service at an airport that connects to a national rail system is different from service that is only local or regional. Also, airport rail service that is more frequent and connected to a large rail system is much different from rail service that is infrequent and may only feature one line of service with limited connectivity. All of these factors must be considered when assessing the quality of air-rail connections.

This leads to consideration of a typology approach. Instead of lumping all air-rail service in one undifferentiated basket, important distinctions must be made. This paper presents and utilizes a hierarchical typology of air-rail connections to differentiate the quality of air-rail service currently operating at US airports.

Following a brief conceptual overview of passenger intermodal literature in different geographic contexts, a hierarchical typology of air-rail connections is presented and used to categorize the fifty largest[1] US airports based on the quality of their air-rail service. More specific descriptions and qualitative assessments of the air-rail connections for each of the airports with direct air-rail service are also provided.

Passenger Intermodalism

The field of transportation is going through revolutionary changes in how people, goods, and information are being moved. Perhaps the largest transformation has been the emergence of an *intermodal* approach to transportation. Even though transportation developed historically as separate modal systems (i.e., water, rail, road, or air transport), there has been a growing realization that there are great efficiencies to be gained through combining modes in the form of integrated intermodal systems. On the freight side, these efficiencies are being realized due to containerization, double-stacking of containers on rail cars, and information systems that permit package tracking and in-transit

[1] based on passenger enplanements

visibility. On the passenger side, efficiencies are created by facilitating connections between modes, such as between automobiles and public transit, or between different public transit modes.

One of the most visible and perhaps the best example of passenger intermodalism is the airport-rail connection. By linking together two passenger modes that are characterized by relatively high speed, the current and future benefits of air-rail connectivity are considerable. On the air side, ongoing aviation growth is outstripping airport and airway capacity, resulting in increased delays, the imposition of slot constraints at the most highly congested airports, and increased costs overall. One policy approach to maximizing airport and airspace capacity, as well as realizing environmental benefits, is to encourage the use of rail transport for shorter-distance trips, thus freeing up air transport capacity for longer distance trips (Givoni 2007). An important pillar of this strategy is an efficient air-rail connection that makes it easier to use rail for shorter trips. On the ground side, increasing automobile congestion, pollution, and energy use have led planners to consider better ways of providing access to airports, especially the creation of airport rail stations on national, regional, or local systems. Depending on numerous factors (e.g., access to an automobile, roadway congestion, origin or destination point), efficient rail service can be the fastest, most convenient, and most cost-effective way to get to and from an airport. Rail service benefits not only those intending to travel by air, but also the many local employees who work at or near airports.

Review of Recent Air-Rail Studies

There have been several recent studies which have shed light on the issue of ground transportation access to airports. The Airport Cooperative Research Program (ACRP) of the Transportation Research Board (TRB) commissioned *ACRP Report 4: Ground Access to Major Airports by Public Transportation* (Coogan 2008), which updated the results of two previous studies commissioned by the Transit Cooperative Research Program (TCRP), *TCRP Report 62: Improving Public Transportation Access to Large*

Airports (Leigh Fisher Associates, Coogan, and MarketSense 2000) and *TCRP Report 83: Strategies for Improving Public Transportation Access to Large Airports* (Leigh Fisher Associates, Coogan, and MarketSense 2002). The ACRP study included a market-based strategy for improving airport ground access, identified attributes of successful ground access systems, and described best practices at US, European, and Asian airports.

The ACRP study also provided a considerable amount of background information including a ranking of US airports by public transportation mode share (see Table 1). According to these data, Washington Reagan National (13%), Atlanta (10%), Oakland (9%), New York JFK (8%), San Francisco (7%), Boston (6%), Chicago Midway (5.5%), Chicago O'Hare (5%) and Newark (5%) had the highest mode shares for rail access to and from U.S. airports. The study considered reasons why some airports have higher public transit mode shares than other airports, including the quality of the airport connection. While the study recognized that a direct airport terminal-rail connection should lead to a higher rail mode share, there are some cases where discrepancies occur. For example, while Washington Reagan National and Atlanta both have direct airport-rail connections and high rail mode shares, Oakland and New York JFK have indirect connections but higher rail mode shares than many other airports with direct airport-rail connections. In particular, it is surprising that Oakland's rail mode share is higher than San Francisco's even though Oakland requires a 3-mile bus connection to rail, while San Francisco has a direct airport-rail connection, and they both connect to the same rail system, i.e., Bay Area Rapid Transit (BART). Nevertheless, when considering all air-rail connections at US, European, and Asian airports, those that have direct airport-rail connections tend to have higher rail mode shares than airports with indirect connections.

The US Government Accountability Office (USGAO 2005) investigated potential strategies for redefining the federal role in developing airport intermodal capabilities at US airports, noting the

benefits that can accrue from improved intermodal ground access to airports. One potential strategy suggested by the USGAO is to increase flexibility in current federal transportation programs to allow more funding of intermodal connections at airports, while a second strategy would be to increase the role of the federal government to develop more integrated air and rail networks. The study found that most major US airports have "direct" connections to local transit systems rather than nationwide bus or rail systems, noting that 27 airports have connections to local rail systems. But as previously mentioned, the USGAO did not differentiate between airports that had direct rail service to the airport terminal and those airports in which shuttles or other connections had to be used to access the local, regional, or national rail system.

A Hierarchical Typology of US Air-Rail Connections

By examining the websites of the 50 largest US airports in terms of enplanements and the associated public transport web sites for the metropolitan areas served by the airports, a hierarchical typology of the different types of passenger plane-to-train connections at airports in the United States was established. The focus of the categories is on seamless connectivity between the airport and national/regional/local rail systems. Five categories are used to distinguish the difference in the degree of connectivity for each airport in the study. The five categories are:

1. Airport is a point on national/regional rail system,

2. Airport is a point on local rail system,

3. Airport has dedicated access (e.g., shuttle, monorail, or other service) to local/regional/national rail system,

4. Airport has public transit access (non-dedicated) to local/regional/national rail system, and

5. Airport has no public transit access to rail system/city has no rail system.

The distinguishing characteristic between category one and category two is the geographic reach of the system to which the airport is connected and the seamlessness of the connection. An airport deemed to be a category one airport would have rail service that was either provided by Amtrak or a regional rail provider that served multiple metropolitan areas from the airport without having to transfer between rail providers or lines. International examples of category one airports would include Frankfurt, Copenhagen and Paris Charles De Gaulle. A category two airport would be an airport that is a stop on a local rail system that serves a metropolitan area and its environs or is linked to a regional/national system through a transfer at another station. International examples of category two systems include Singapore, London Heathrow, and Sydney.

The main difference between category three and four airports is the dedication of the connecting service between the airport and the offsite rail service. Category three airports are characterized by a dedicated link, usually a shuttle bus, an automated people mover, or other type of road transportation, to an existing local/regional rail system away from the airport. Airports falling into category four have access to a local/regional rail system as a stop on a bus route that is not solely operated as a bridge between the airport and the local/regional rail system. Category five airports either have no public transit connection to the rail system or the metropolitan area they serve has no existing rail system at present.

Currently, no airports in the United States are category one airports. Two of the top 50 airports are close to having a category one plane/train connection: Newark Liberty International Airport in Newark, New Jersey and Baltimore/Washington Thurgood Marshall International Airport (Providence T.F. Green Airport would also be included here if it ranked in the top 50 airports). Newark's AirTrain connection is a 1.9 mile-long monorail system linking the airport to Newark Liberty International Airport Train Station which is part of the Northeast Corridor service by Amtrak and part of NJ Transit's regional

service. The AirTrain serves not only as a link between the station and the airport but also serves as terminal connector at the airport and a connector between parking lots and the terminals at the airport. Baltimore's airport has a dedicated bus service to an Amtrak and Maryland Area Regional Commuter (MARC) rail station that is located on the airport property but not physically connected to the passenger terminal.

Twelve airports are categorized as airports being a point on a local rail system (See Table 2). A majority of the airports that fall into this category share two common characteristics in regards to their plane/train connection. Due to the nature of airport operations that: a) need to be located away from other land uses, b)need a large amount of space, and c) have only recently been connected to rail networks, the airport rail stations are typically end points on most of the networks examined. Cities expecting to connect their airports to existing or planned rail lines (e.g., Denver) have placed the airport at the endpoint of a line as well. Within this category there is a mix of airports that have been connected to an existing rail system (e.g., Chicago Midway and San Francisco), as well as airports that were part of the initial rail network of a metropolitan area, including airports serving Saint Louis and Portland, Oregon.

One way that airports and cities attempt to connect rail and air systems is through a dedicated service from the airport to an offsite train station that is part of the city's rail service. This type of connection is found at 11 of the airports in the study group and can take the form of a monorail system such as the one previously mentioned for Newark or the AirTrain connecting New York's JFK airport to both the Long Island Railroad and the NYC MTA subway system. In some cases, such as in Dallas-Fort Worth and Oakland, a bus or shuttle system moves travelers between the airport and the nearest rail station. At Boston Logan Airport, a free shuttle bus links to the MBTA Blue line rail transit, and the new MBTA Silver Line bus rapid transit provides service from the airport to several stops including South

Station (with MBTA commuter rail and Amtrak service on the Northeast Corridor). The decision to use a dedicated bus or shuttle system can be economically based as it is obviously cheaper than constructing a rail system to connect the nearest station. A shuttle system may be used as a temporary measure until a new line or spur is built incorporating the airport into the rail system, or it may be used indefinitely because it is inefficient, difficult, and/or costly to construct an on-airport station.

There are three category 4 airports (New York LaGuardia, Salt Lake City International, and San Diego Lindbergh). These have a public transit connection to an existing train system but are different than category 3 airports in that the connection is not a dedicated one but is instead part of a geographically larger rail or bus route that serves other destinations beyond the airport and the rail station.

The final categorization is straightforward, no plane/train connections, however the reason for the lack of connectivity between the two modes varies throughout the group. This group can be broken into two sub categories, those airports that are located in cities with no public rail transport and those airports located in cities with public rail transport but no connectivity between the two modes. Those airports in the latter classification include a number of airports that, while not presently connected to an existing rail system, have plans to connect them in the future. Denver area citizens voted in favor of a referendum in 2004 to connect Denver International Airport to the city's existing light rail system with a commuter rail line that will run from the airport to the city's intermodal hub at Union Station. Other cities that have explored train/plane connections to their existing rail systems include Las Vegas and Charlotte, though both cities are in the early planning stages. Another group of cities in this classification have an existing rail system but have chosen not to incorporate their airport into the system. Examples include Nashville and both airports serving Houston.

The relatively poor image of US public transit and the American psyche concerning the use of public transit has had an enormous effect on the development and quality of plane/train connections. Another factor explaining in particular the lack of regional and national rail connections at US airports is the differing eras of rail and air transport development in American history. During rail's heyday elaborate rail stations were built in American downtowns. As mentioned earlier the nature of airports saw them being built on the fringes of metropolitan areas away from downtowns. The rise of private automobile use, the interstate highway system and associated multilane high speed limited access highways and the subsequent sprawling nature of urban land use made it difficult if not impossible for rail to connect a large number of destinations efficiently. Developers of the systems focused resources on connecting residential areas with employment centers. Only recently have transit planners seen the benefits of plane/train connections, at least at the local level, and have begun to connect the two modes of transport.

The Quality of Air-Rail Connections at Specific US Airports

The following discussion highlights some specific air-rail connection qualities of each of the twelve category 2 airports (in alphabetical order) that represent the best connections among the top 50 airports in the United States.

Atlanta Hartsfield

Hartsfield Atlanta International Airport is the southernmost station on Metropolitan Atlanta Rapid Transit Authority's (MARTA) North-South Rail Line which connects to the rest of the MARTA train system at the Five Points Station in downtown Atlanta, 10 minutes to the north of the airport (http://www.itsmarta.com/airport.aspx Accessed January 30, 2010). A passenger or employee wishing to use the plane-train connection faces a relatively seamless journey as the airport rail station is located with other ground transportation services at the main terminal complex. The airport's plane-train

connection is one of the better ones in the United States due to the easy accessibility of the station in the terminal and the fairly extensive network of the MARTA Rail System (see Figures 2 & 3).

Baltimore-Washington International

Baltimore Washington Thurgood Marshall International Airport has a number of different plane-train connections serving the airport. The airport's light rail station, which is located within the airport terminal, is the southernmost end point of Hunt Valley-BWI Airport line. BWI also has a free dedicated bus shuttle that connects the terminal to an on-property rail station. This rail station provides Amtrak service on the Northeast Corridor as well as access to the MARC rail network which serves Baltimore, Washington D.C. and the surrounding metropolitan areas (http://www.mtamaryland.com/services/marc/schedulesSystemMaps/marcTrainSystemMap.cfm Accessed January 30, 2010). The only attribute keeping BWI's plane-train service from being considered a complete Category 1 plane-train intermodal connection is the location of the regional and national train connections away from the terminal instead of within the terminal itself. However, the short (approximately 3-minute bus ride), free, and dedicated shuttle service connecting the airport terminal to the train station makes BWI one of the top plane-train airports in the United States (see Figures 4, 5 & 6).

Chicago O'Hare and Midway

Both of Chicago's major airports, O'Hare and Midway, have similar plane-train connections. O'Hare is connected to the Chicago Transit Authority (CTA)'s rail system as the westernmost point of CTA's Blue Line. Trains leave the O'Hare station every 6-10 minutes for the approximately 45-minute journey into downtown Chicago where passengers can change trains to reach other areas outside the downtown (http://www.transitchicago.com/riding_cta/systemguide/blueline.aspx Accessed January 30,

2010). The CTA station is centrally located between Terminals One, Two and Three at the airport, roughly 500 feet from baggage claim and check-in for any of the three terminals.

Chicago Midway is the endpoint for CTA's Orange Line with trains leaving the airport station every 7-10 minutes for the 30 minute ride to the Loop/Downtown area (http://www.transitchicago.com/riding_cta/systemguide/orangeline.aspx Accessed January 30, 2010). The train station at Midway opened in 1993 and despite the new Midway main terminal built in 2001, the train station is not directly in the terminal, but connected to the terminal's parking garage which is adjacent to the terminal building and requires a 5-10 minute walk. Both Chicago airports have good plane-train connections for United States airports with the only drawbacks being their place within the CTA's train network. The geography of the CTA's train network is finger-like and traveling to destinations off of either the Blue or Orange lines or outside downtown entails traveling to downtown Chicago first and then changing trains to reach destinations not served by the two lines serving the airports (see Figures 7, 8, & 9).

Cleveland Hopkins

Cleveland Hopkins International Airport has one of the easiest, well designed plane-train connections in the United States (TCRP Report 62, 2000). The airport was the first in the United States to have an in-terminal train station connecting the airport to the city's train network in 1968 (http://www.clevelandairport.com/site/413/default.aspx Accessed January 30, 2010). The Greater Cleveland Regional Transit Authority (RTA) train service runs every 15 minutes to and from the airport along the RTA's red line to downtown Cleveland in approximately 30 minutes (http://www.clevelandairport.com/site/518/default.aspx Accessed January 30, 2010). As with other metro rail line connections to airports in the United States, the Cleveland Hopkins train station is the westernmost terminus point on the RTA's red line and passengers wanting to reach destinations not on

the airport line must travel into downtown and transfer to other train lines (see Figure 10). Furthermore, the entire Cleveland rail network is relatively small, with only 42 track miles of heavy rail and 33 track miles of light rail (APTA 2007).

Minneapolis-St Paul International

Minneapolis-St. Paul International Airport has two stops on the Metro Transit Hiawatha Line, one at the main Lindbergh Terminal and one at the Humphrey Terminal. Light rail is a relatively new addition to the Minneapolis/St. Paul public transit system, beginning service in 2004. This fledgling system only has one 24-mile line limiting the number of destinations reachable by rail from the airport. One of the distinctive features of the line in addition to having two stops at the airport is the position of the airport within the rail network (http://www.metrotransit.org/rail/index.asp Accessed January 30, 2010). Unlike other airports that are a terminus of the line serving them, the MSP airport has service to the north towards downtown Minneapolis and to the south ending at the Mall of America (see Figures 11 & 12).

Philadelphia International

Philadelphia International Airport is connected to the Southeastern Pennsylvania Transportation Authority's (SEPTA) High Speed Rail Line. The train makes only two stops between the airport and the 30th Street station where passengers can connect to local destinations on the SEPTA train system or regional and national train service provided by Amtrak and New Jersey Transit (http://www.septa.org/maps/click_map.html Accessed January 30, 2010). Philadelphia's plane-train connections are among the best in the United States because of the ease of access at the airport as the train stops at all of the airport terminals instead of passengers having only one access point at the airport. Also, the extensive network the system provides through SEPTA and the additional connections

to regional and national destinations through other providers make the Philadelphia air-rail connection a good one (see Figures 13 & 14).

Portland International

The plane-train connection at Portland International Airport is provided by the region's public transportation provider TriMet. The airport train station is located within the main terminal of the airport and is the terminus point on the system's 25.5 mile long Red Line, one of three lines in TriMet's 93-mile light rail system (http://www.trimet.org/schedules/r100rtext.htm Accessed January 30, 2010). The train departs the airport approximately every 15 minutes for the roughly 30-minute ride to downtown Portland. Along the route, passengers have transfer access to both the Blue Line that serves eastern destinations within the network along with western destinations beyond the western terminus of the Red Line. Portland's plane-train connection is efficient for passenger use due to the station's in-terminal location; the only drawback is the train's limited regional network though the service within the Portland metropolitan area is relatively extensive (see Figures 15 & 16).

St Louis Lambert

St. Louis Lambert International Airport is the terminus on the red line for MetroLink, the St. Louis metropolitan light rail system. MetroLink serves 46 miles of track in both Missouri and Illinois. The MetroLink has a roughly linear route system (an additional line departs the mainline seven stations from the airport making for a "Y" route configuration) that includes stops in downtown St. Louis and plans are in the works to connect the easternmost station in Illinois to MidAmerica Airport, which would complete a system-wide airport-to-airport connection (http://www.metrostlouis.org/InsideMetro/QuickFacts/metrolink.asp Accessed January 30, 2010). While the MetroLink has two stations at the two terminals at STL, the linearity of the system's network limits the direct destinations passengers have using the plane-train connection (see Figures 17 & 18).

San Francisco International

San Francisco International Airport's plane-train connection is a new addition to the airport which is somewhat surprising considering the city and region's dedication to being at the forefront in public transportation. Thirty-one years after the Bay Area Rapid Transit (BART) train system began service, the airport was finally connected to the network in 2003. Passengers access BART at a brand new in-terminal train station allowing passengers to travel north into downtown San Francisco and into the majority of the rest of BART's 104-mile network or head south to the Millbrae station where passengers can access CalTrain service to San Jose and the Silicon Valley (http://www.bart.gov/about/history/systemFacts.asp Accessed January 30, 2010). The plane-train connection at SFO is one of the best in the United States due to the scope of the network provided by BART and the ease of access provided by the in-terminal train station (see Figures 19 & 20).

Seattle-Tacoma International

Seattle-Tacoma international Airport is the most recent airport to open a rail station at the airport. The station is the southern terminus for Sound Transit's Central Link light rail line and connects the airport to downtown Seattle, the northern terminus of the system, in approximately 30 minutes. The light rail line also connects to the Sounder commuter rail line and Amtrak Cascadia service at the International District/Chinatown & King Street station. To access the station, passengers must depart the main terminal and follow a designated path through the parking garage and then across a pedestrian walkway to the rail station (http://www.soundtransit.org/Riding-Sound-Transit/Schedules-and-Facilities/Transit-Facilities/SeaTac-Airport-Link-Station.xml Accessed January 30, 2010). As with some other systems, destinations are limited because of the linearity of the rail network (see Figures 21 & 22).

Washington DC Reagan National

Washington D.C.'s Reagan National Airport has access to the extensive Washington D.C. Metro system through a multi-directional station connected to the terminal through two covered pedestrian walkways (http://www.metwashairports.com/reagan/about_reagan_national/directions_maps_reagan/metrorail_map Accessed January 30, 2010). The extensive network of the Metro, 106 miles of track, and the direct linkage to Washington Union Station where regional and national rail service can be accessed makes the airport one of the leaders in plane-train connections in the United States (see Figures 23 & 24).

Summary and Conclusions

Two components are considered necessary for quality air-rail connections: a rail station at the airport that is easily accessed by users of the system and a rail network that connects the airport to a wide range of destinations. In this study, we have differentiated between airports that have rail stations directly at airport terminals (accessible by walking) and those which have rail stations that are accessible only through shuttles or other connectors from the airport. We have also differentiated between airports that connect to national rail systems and those that connect to local or regional rail systems. A number of United States airports feature stations that meet the first criteria. It is the second criteria, rail networks, which ultimately limit the quality of air-rail connections in the United States.

There are no airports in the US that feature a station at the terminal that is part of a national passenger rail network, unlike the situation in many European and Asian cities. This is largely due to the poorly developed national passenger rail system in the US today. A number of different factors have contributed to this lack of development, including such issues as the decision to pursue individual mobility through the construction of the Interstate Highway system and pursuit of private automobile ownership, the location of airports on the periphery of metropolitan areas away from existing rail

stations, and the vast geographic extent of the country making rail impractical for long distance travel. More recently, there have been plans announced by the US Department of Transportation to develop high-speed rail corridors linking major cities that could play an important role in connecting airports within intermediate-distance (200-500-mile) city-pair markets.

There are twelve US airports that have a direct on-airport connection to a local rail transit station. Airports such as Atlanta Hartsfield, Baltimore-Washington International, Chicago O'Hare and Midway, Philadelphia International, Portland International, San Francisco International, and Washington Reagan National are in this category, and are considered by us to be among the best examples of air-rail connections among the top 50 airports in the US. The recent growth in local and regional rail transit systems in the United States is leading a number of other airports/communities to either build or plan rail stations at their respective airports. Airports that have either just completed or are planning to construct airport rail stations include Phoenix, Seattle, Salt Lake City, and Denver. However, new construction does not necessarily mean a quality connection if both of the previously mentioned criteria are not met, in-terminal rail station and expansive rail network.

The issue of meeting the first criterion is difficult as rail stations must be retrofitted to existing airport terminals and rail lines must snake their way through existing development to reach the airport. One way around this is to place the station away from the terminal on the periphery of the airport property but by doing so, it decreases the quality of the air-rail connection. The second criterion of network scope is even more difficult to overcome as rail lines are expensive to build and are generally focused on providing local or regional service with the airport usually being an end stop on a spoke line. This limits the number of destinations that can be efficiently reached from the airport, thus limiting the quality of the air-rail connection. The strategy of pursuing high speed rail spearheaded by the United

States Federal Government would appear to have the potential to help boost air-rail quality by enhancing rail network connectivity around the country.

The quality of air-rail connections at airports in the United States continues to be less than optimal when examined at a national scale because of the poor quality of national rail service in the country. When examined at a local scale, the quality improves and the number of metropolitan areas recognizing the benefits of connecting their urban rail systems to their airports with in-terminal rail stations is increasing.

References

Coogan, Matthew A., in association with MarketSense Consulting LLC and Jacobs Consultancy. 2008. *Airport Cooperative Research Program [ACRP] Report 4: Ground Access to Major Airports by Public Transportation*. Washington, DC: Transportation Research Board, National Research Council.

Givoni, Moshe. 2007. Air-Rail Intermodality from Airlines' Perspective. *World Review of Intermodal Transportation Research* 1(3): 224-238.

Leigh Fisher Associates, Matthew A. Coogan, and MarketSense Consulting LLC. 2002. *TCRP Report 83: Strategies for Improving Public Transportation Access to Large Airports*. Washington, DC: Transportation Research Board, National Research Council.

_____. 2000. *TCRP Report 62: Improving Public Transportation Access to Large Airports*. Washington, DC: Transportation Research Board, National Research Council.

USGAO [United States Government Accountability Office]. 2005. *Intermodal Transportation: Potential Strategies Would Redefine Federal Role in Developing Airport Intermodal Capabilities*. GAO-05-727. July 26, 2005.

TABLES AND FIGURES

Table 1: Public Transportation Mode Shares to U.S. Airports

		Market Share		
Rank	Airport	Total	Rail	Bus/Van
1	San Francisco	23%	7%	16%
2	New York JFK	19%	8%	11%
3	Boston	18%	6%	12%
4	Reagan National	17%	13%	4%
5	Oakland	15%	9%	6%
6	New Orleans	15%	0%	15%
7	Newark	14%	5%	9%
8	Atlanta	14%	10%	4%
9	Denver	14%	0%	14%
10	Los Angeles	13%	0%	13%
11	Baltimore/Washington	12%	3%	9%
12	Chicago O'Hare	12%	5%	7%
13	Las Vegas	12%	0%	12%
14	Orlando	11%	0%	11%
15	Seattle	11%	0%	11%
16	Portland	10%	6%	4%
17	Chicago Midway	9%	5.5%	4%
18	Phoenix	9%	0%	9%
19	San Diego	9%	0%	9%
20	Indianapolis	9%	0%	9%
21	Washington Dulles	8%	1%	7%
22	New York LaGuardia	8%	1%	7%
23	Philadelphia	7%	3%	4%
24	Tampa	7%	0%	7%
25	Dallas/Fort Worth	6%	0%	6%
26	St. Louis	6%	3%	3%
27	Cleveland	6%	2%	4%

Source: ACRP Report 4: Ground Access to Major Airports by Public Transportation (2008).

Table 2: Categorization of Largest 50 U.S. Airports Based on the Quality of Air-Rail Connection

Category 1: Airports are points on national/regional rail system

There currently are no U.S. airports that have direct, on-terminal rail stations for a national or inter-metropolitan rail system.

Category 2: Airports are points on a local rail system

Atlanta, Georgia (William B. Hartsfield-Atlanta Intl.)
Baltimore, Maryland (Baltimore-Washington Intl.)
Chicago, Illinois (Chicago Midway)
Chicago, Illinois (Chicago O'Hare Intl.)
Cleveland, Ohio (Cleveland-Hopkins Intl.)
Minneapolis/St. Paul, Minnesota (Minneapolis-St. Paul Intl.)
Philadelphia, Pennsylvania (Philadelphia Intl.)
Portland, Oregon (Portland Intl.)
San Francisco, California (San Francisco Intl.)
St. Louis, Missouri (Lambert-St. Louis Intl.)
Seattle, Washington (Seattle-Tacoma Intl.)
Washington, DC (Ronald Reagan Washington National)

Category 3: Airport has dedicated access to local/regional/national rail system

Baltimore, Maryland (Baltimore-Washington Intl.) [has access to national and regional rail systems]
Newark, New Jersey (Newark Intl.) [has access to national and regional rail systems]
Boston, Massachusetts (Logan Intl.)
Dallas/Ft. Worth, Texas (Dallas/Ft. Worth Intl.)
Ft. Lauderdale, Florida (Fort Lauderdale-Hollywood Intl.)
Los Angeles, California (Los Angeles Intl.)
Miami, Florida (Miami Intl.)
New York, New York (John F. Kennedy Intl.)
Oakland, California (Metropolitan Oakland Intl.)
Phoenix, Arizona (Phoenix Sky Harbor Intl.)
San Jose, California (San Jose Intl.)
Washington, DC (Washington Dulles Intl.)

Category 4: Airport has public transit access (non-dedicated) to local/regional/national rail system

New York, New York (La Guardia)
Salt Lake City, Utah (Salt Lake City Intl.)
San Diego, California (San Diego Intl./Lindbergh Field)

Category 5: Airport has not access to rail system/city has no rail system

Austin, Texas (Austin-Bergstrom Intl.)
Charlotte, North Carolina (Charlotte-Douglas Intl.)
Cincinnati, Ohio (Greater Cincinnati)
Denver, Colorado (Denver Intl.)
Detroit, Michigan (Detroit Metro Wayne County)
Hartford, Connecticut (Bradley Intl.)

Honolulu, Hawaii (Honolulu Intl.)
Houston, Texas (George H.W. Bush Intercontinental)
Houston, Texas (William P. Hobby)
Indianapolis, Indiana (Indianapolis Intl.)
Kansas City, Missouri (Kansas City Intl.)
Las Vegas, Nevada (McCarran Intl.)
Memphis, Tennessee (Memphis Intl.)
Nashville, Tennessee (Nashville Intl.)
New Orleans, Louisiana (New Orleans Intl./Moisant Field)
Ontario/San Bernardino, California (Ontario Intl.)
Orlando, Florida (Orlando Intl.)
Pittsburgh, Pennsylvania (Pittsburgh Intl.)
Raleigh/Durham, North Carolina (Raleigh-Durham Intl.)
Sacramento, California (Sacramento Intl.)
San Antonio, Texas (San Antonio Intl.)
Santa Ana, California (John Wayne-Orange County)
Tampa, Florida (Tampa Intl.)

Source: Authors' calculations

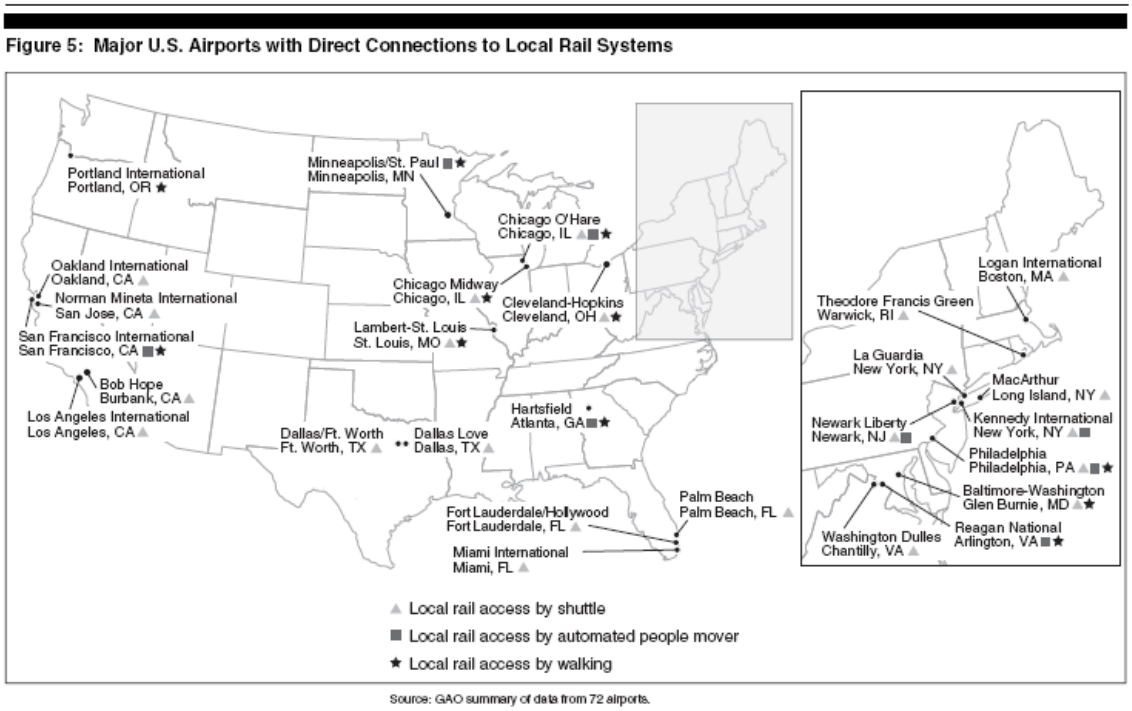

Figure 1: Map from US Government Accountability Office (2005) report illustrating major U.S. airports with “direct” connections to local rail systems. Source: USGAO 2005.

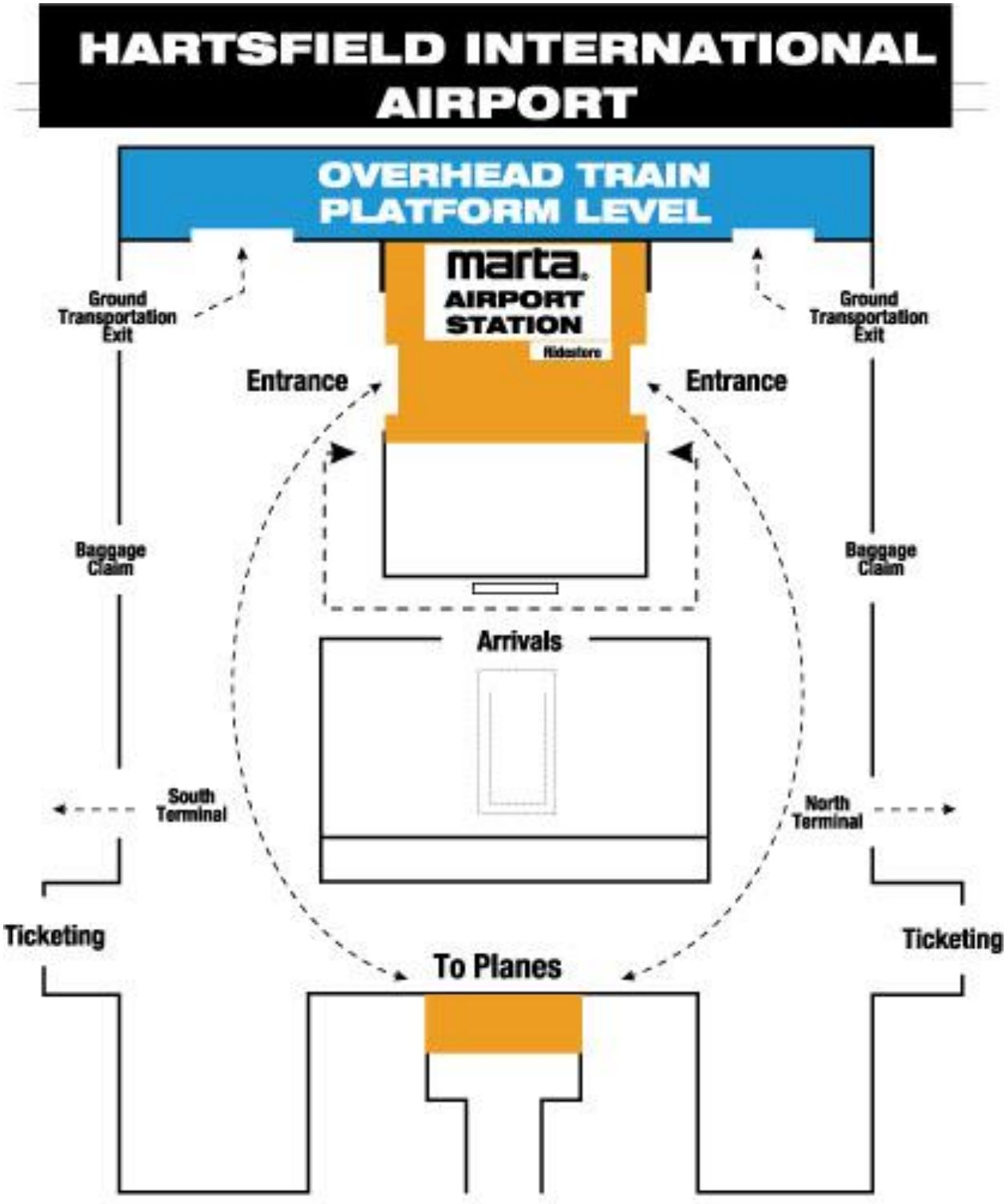

Figure 2: Atlanta Hartsfield Airport Station

Figure 3: Atlanta MARTA Rail Transit Network

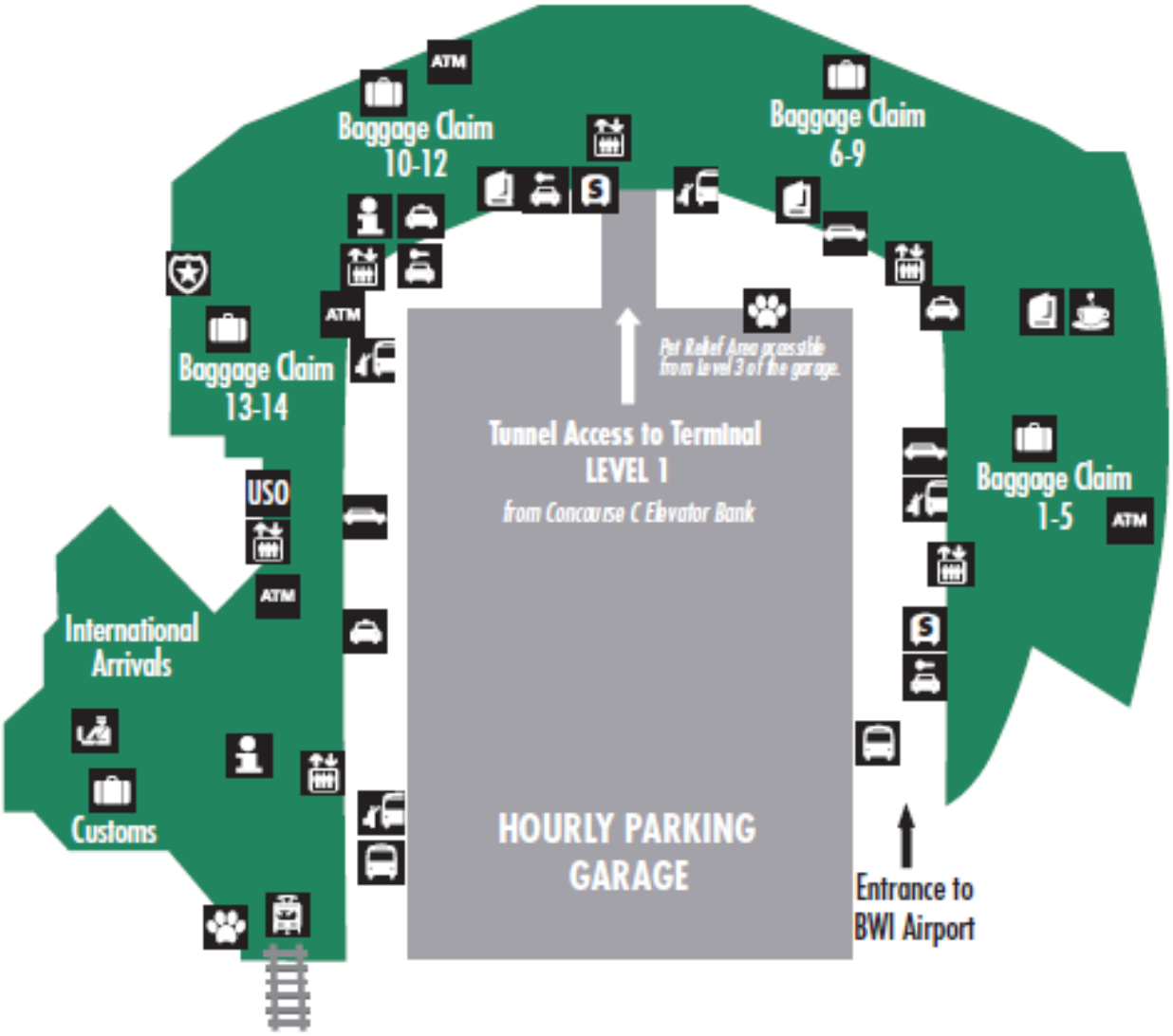

Figure 4: Baltimore-Washington International Airport and Light Rail Station Location

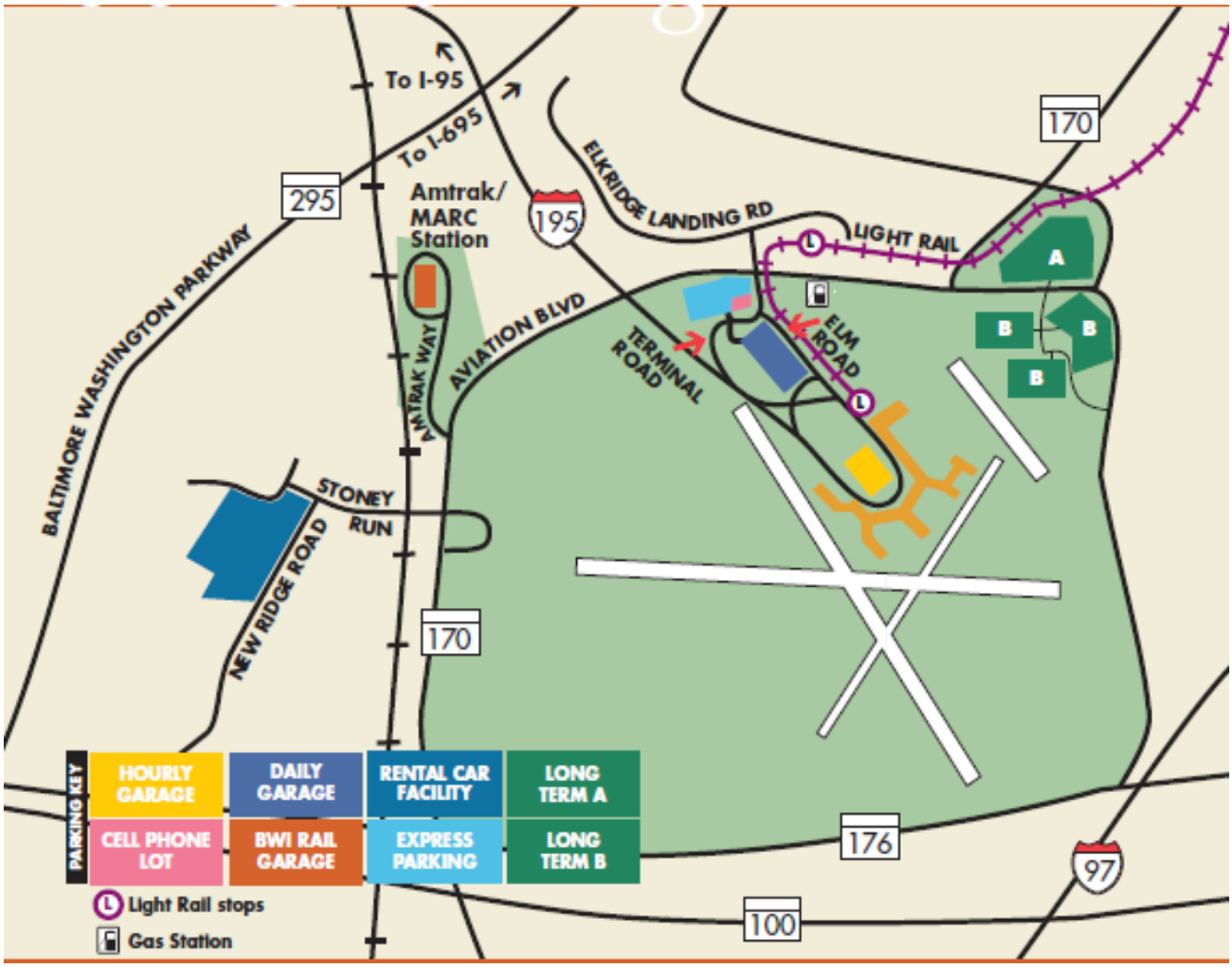

Figure 5: Baltimore-Washington International Airport with Light Rail Station and Amtrak/MARC Station

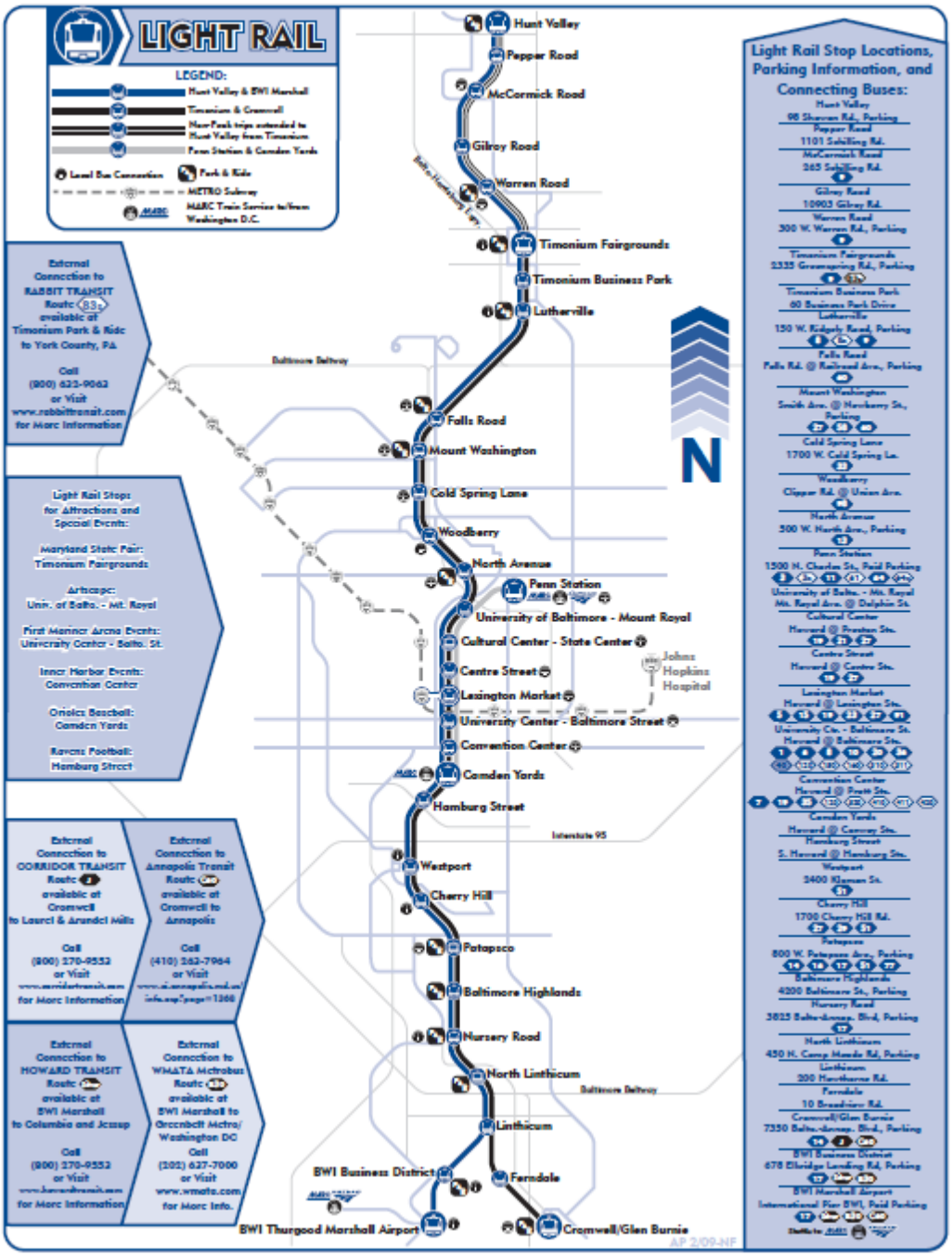

Figure 6: Baltimore Light Rail Network

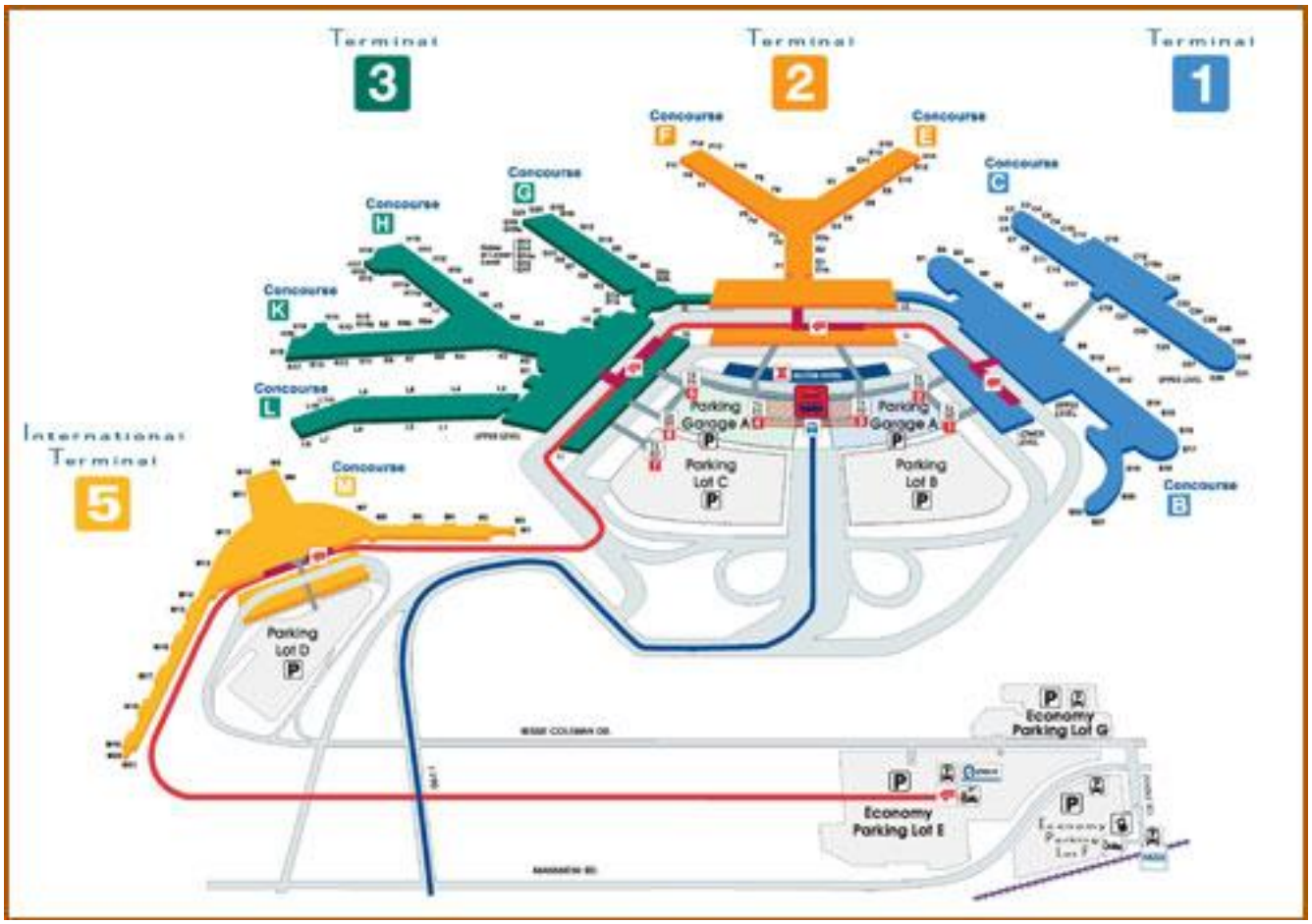

Figure 7: Chicago O'Hare Airport and CTA Blue Line Rail Transit Station

Figure 8: Chicago Midway Airport and CTA Orange Line Station

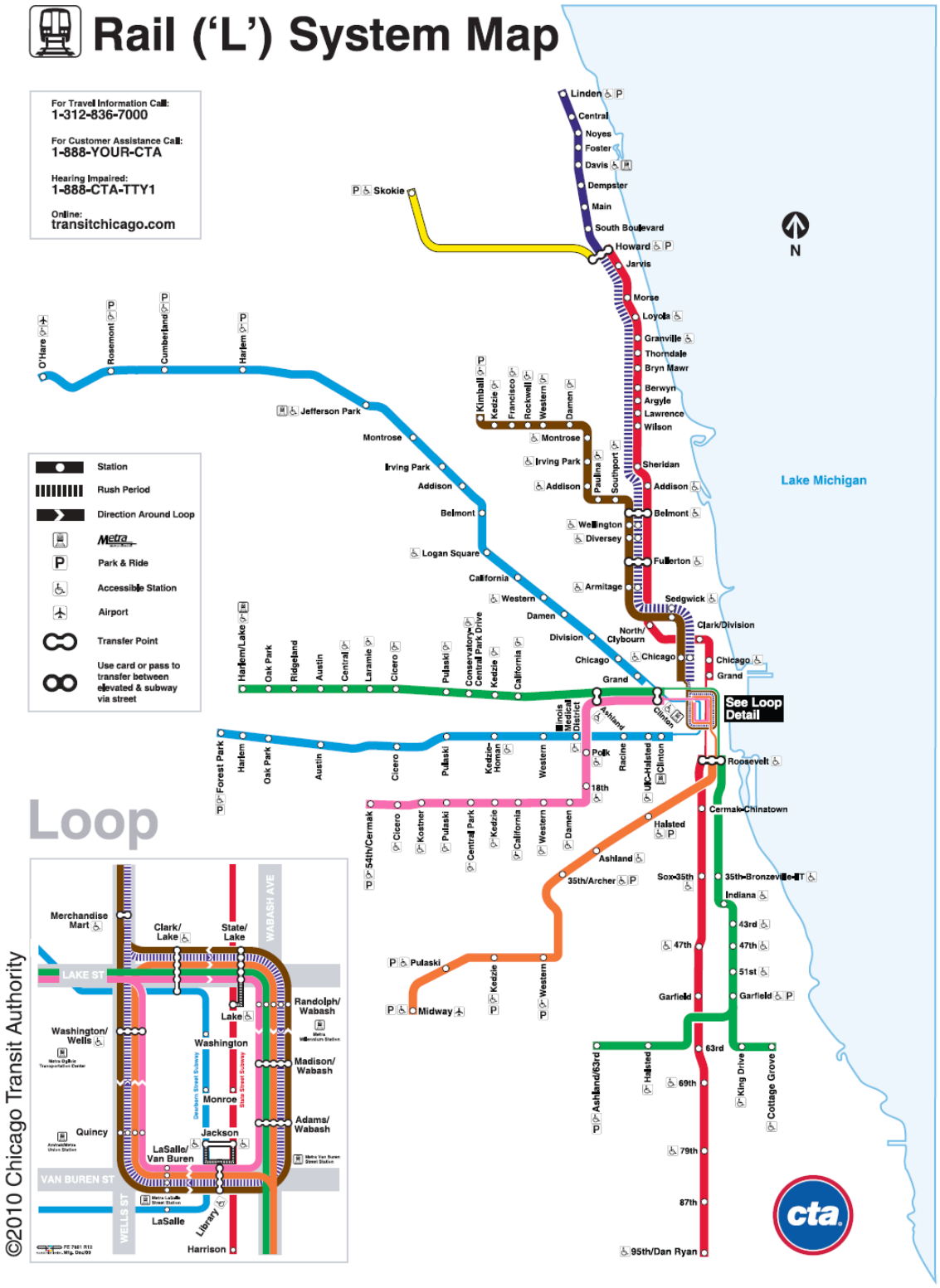

Figure 9: Chicago CTA Rail Transit System

Figure 10: Cleveland GCRTA Rail Rapid Transit System

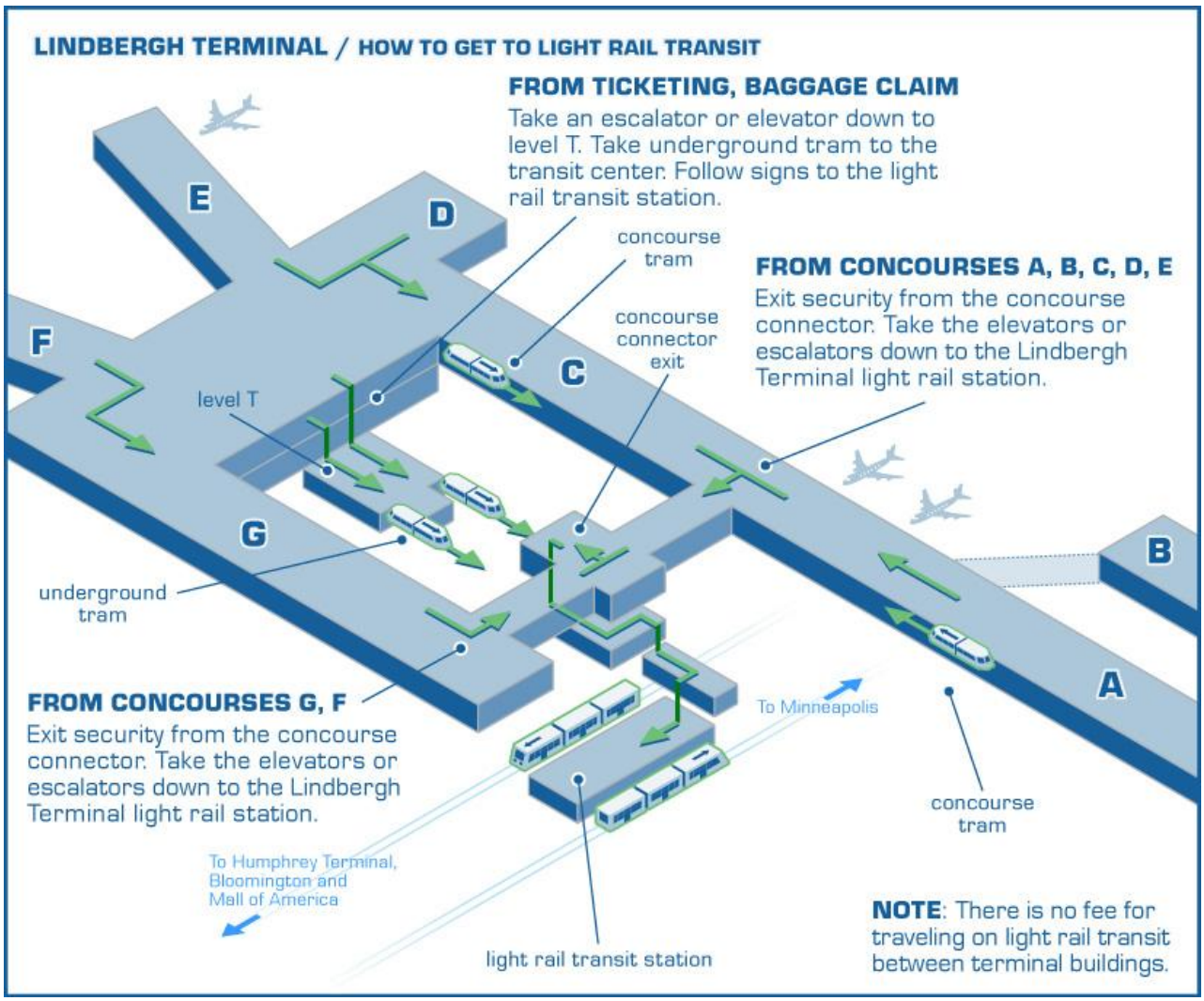

Figure 11: Minneapolis International Airport Light Rail Transit Station

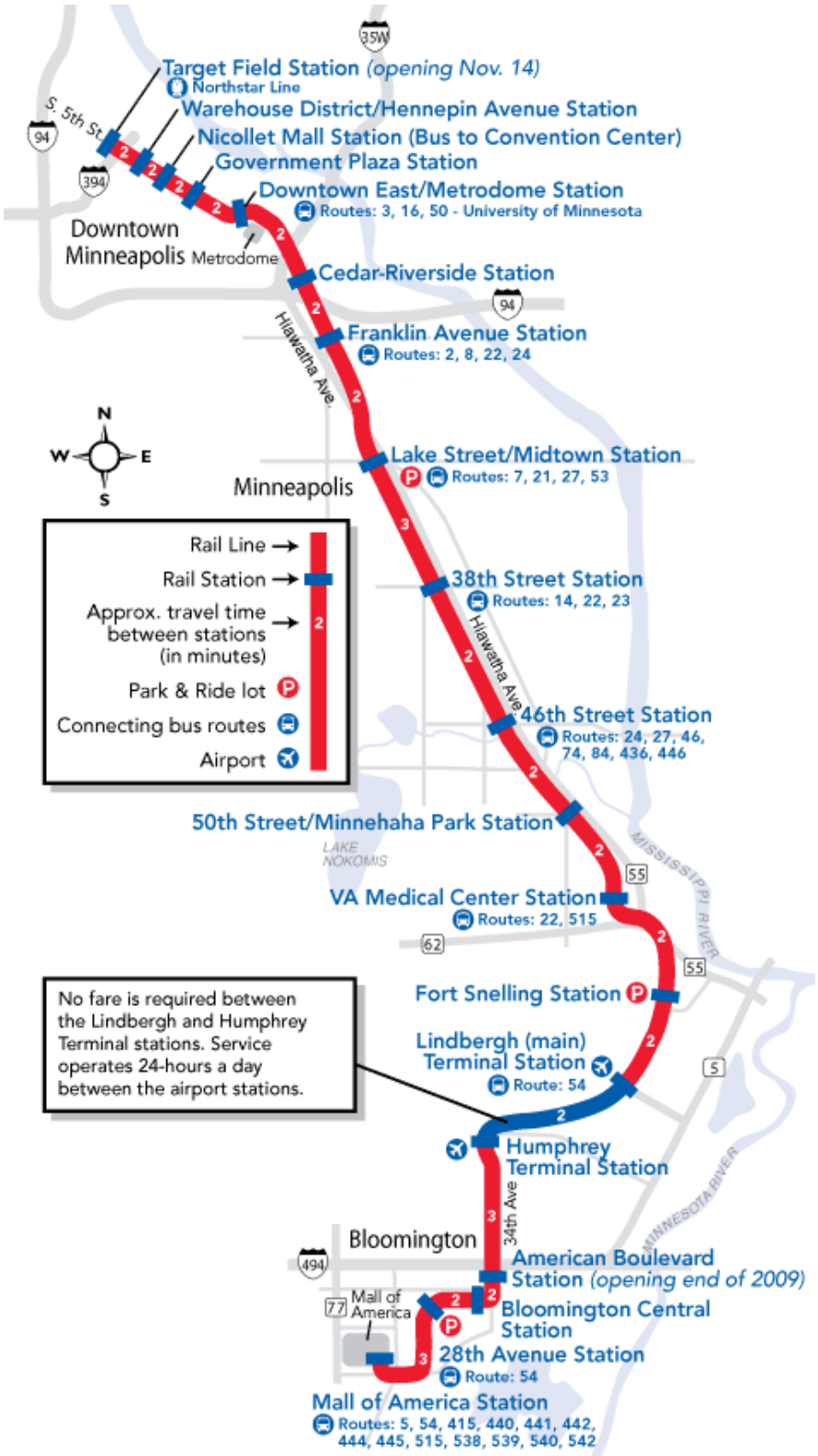

Figure12: Minneapolis Light Rail Line

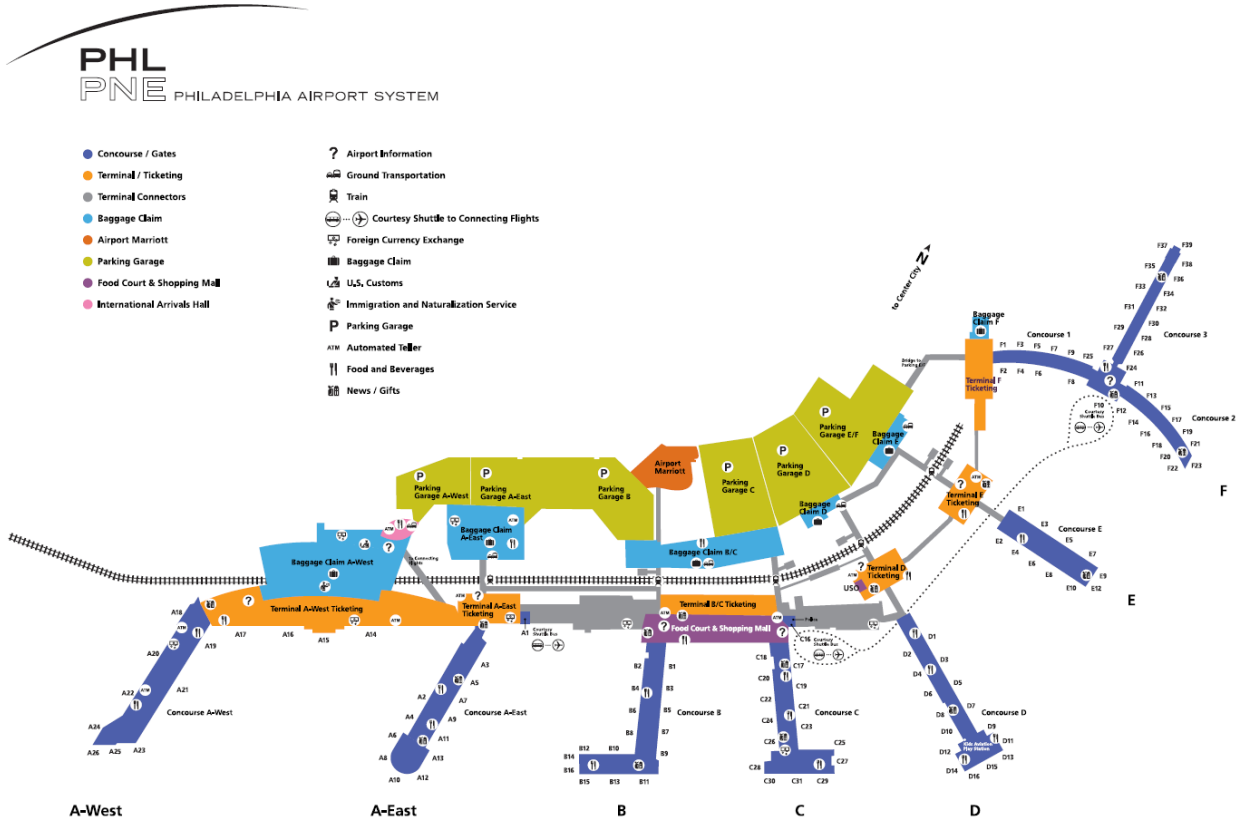

Figure 13: Philadelphia International Airport Rail Transit Station

Figure 14: Philadelphia SEPTA Rail Transit Network

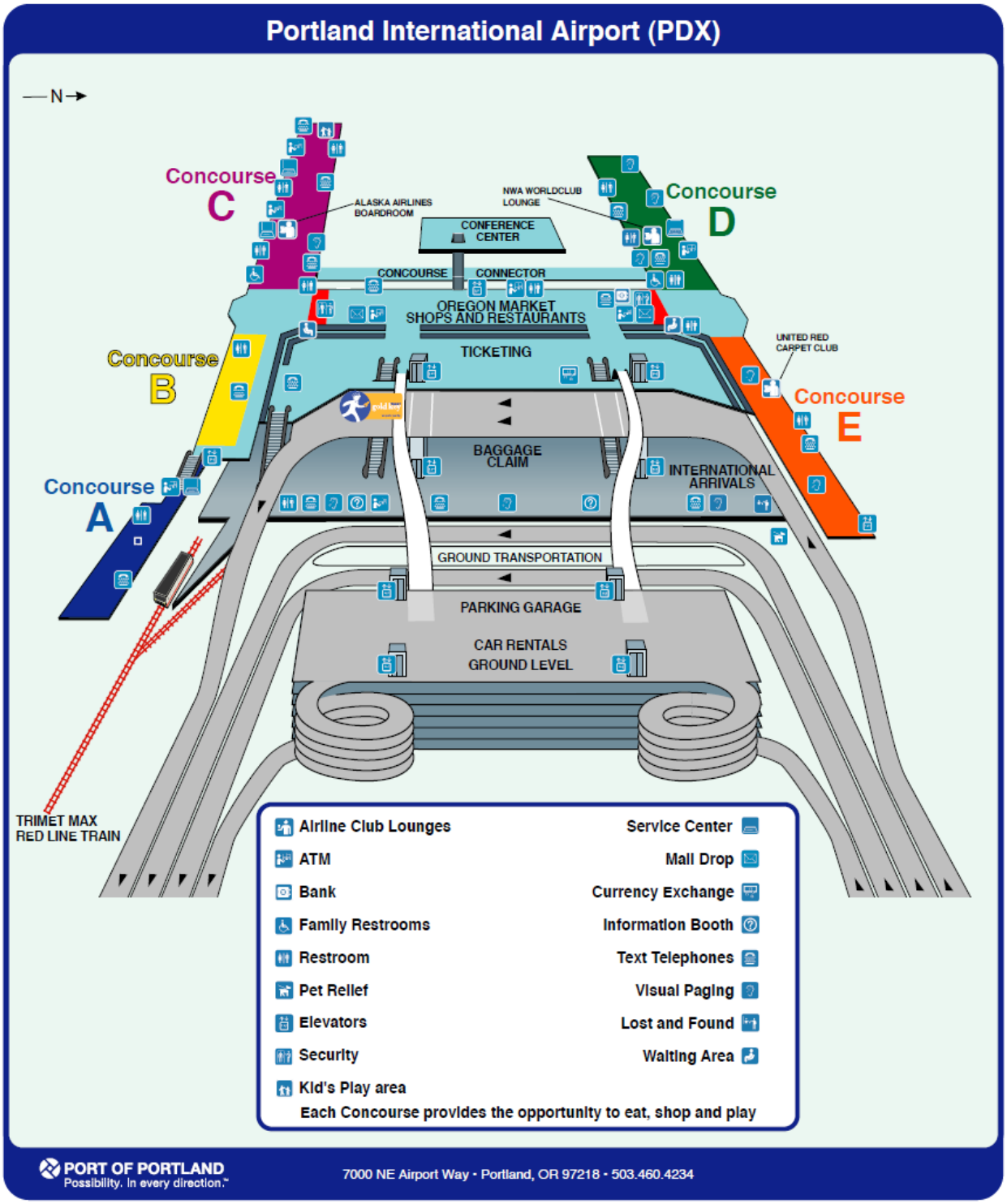

Figure 15: Portland International Airport and Trimet Max Red Line Train Station

Figure 16: Portland Trimet Rail Transit System

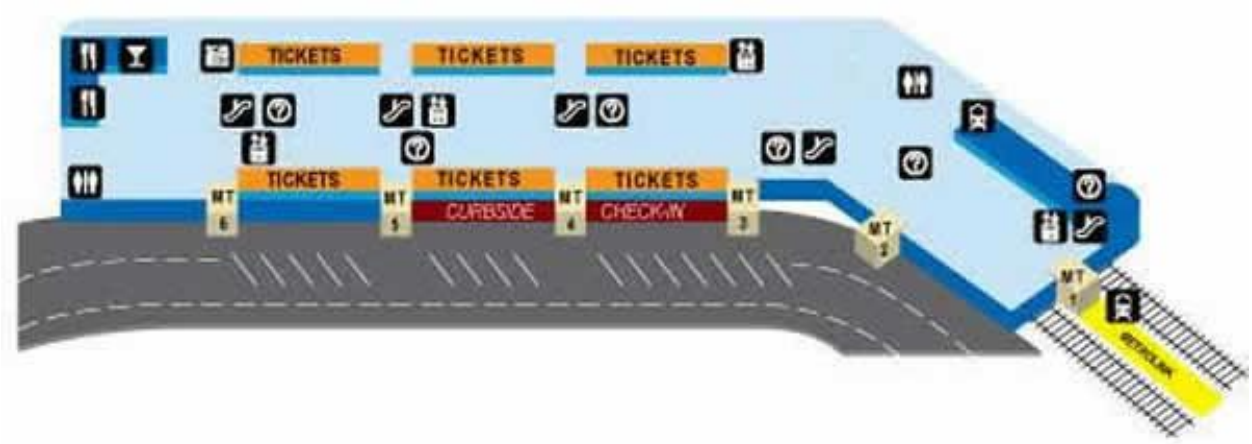

Figure 17: St. Louis Lambert Airport Rail Transit Station

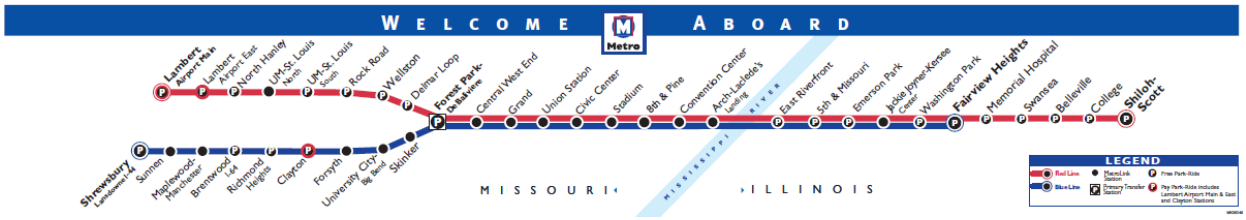

Figure 18: St. Louis Metro Rail Transit System

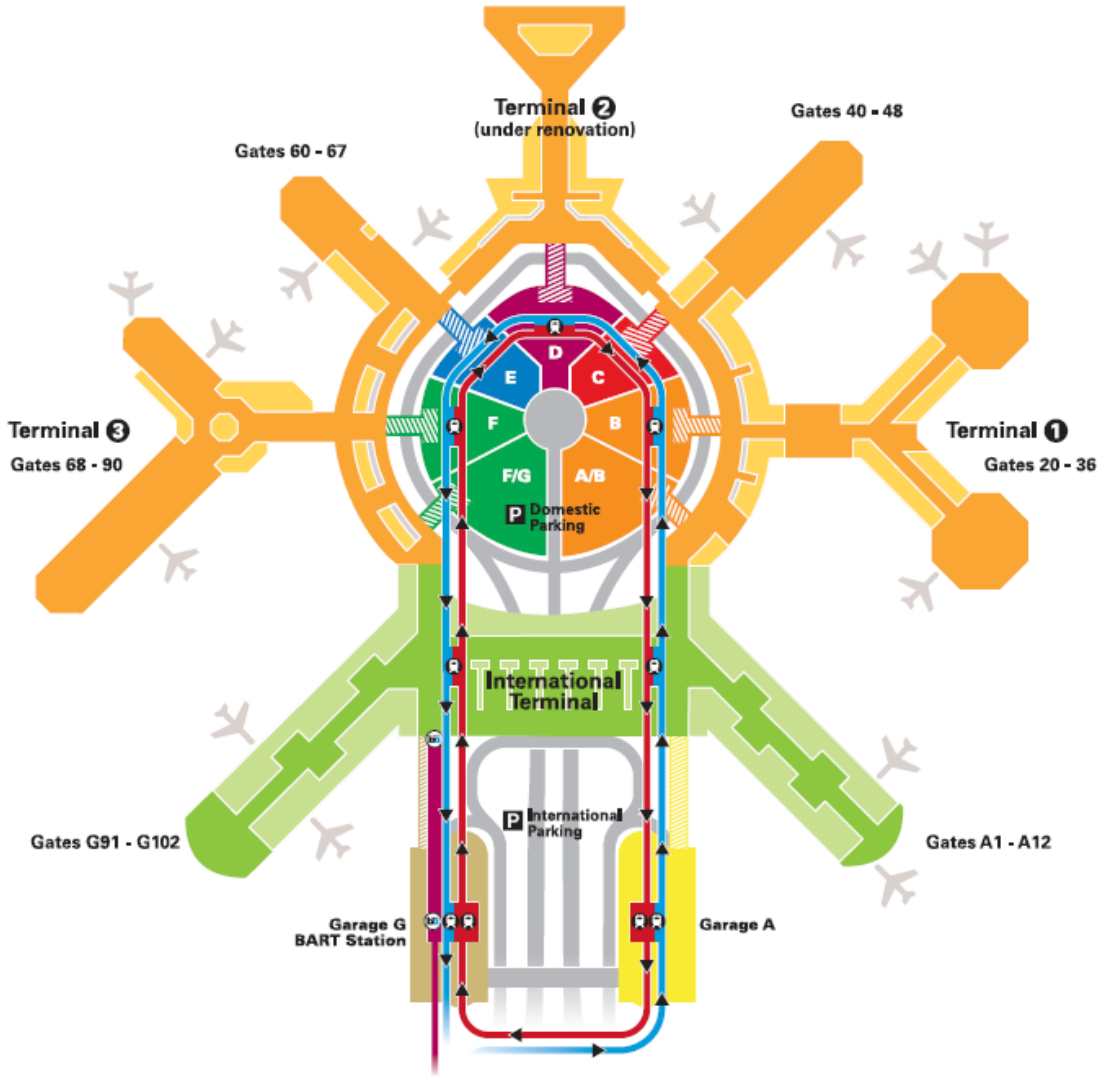

Figure 19: San Francisco International Airport BART Rail Transit Station

Figure 20: San Francisco BART Rail Transit System

Figure 21: Seattle-Tacoma International Airport Light Rail Station

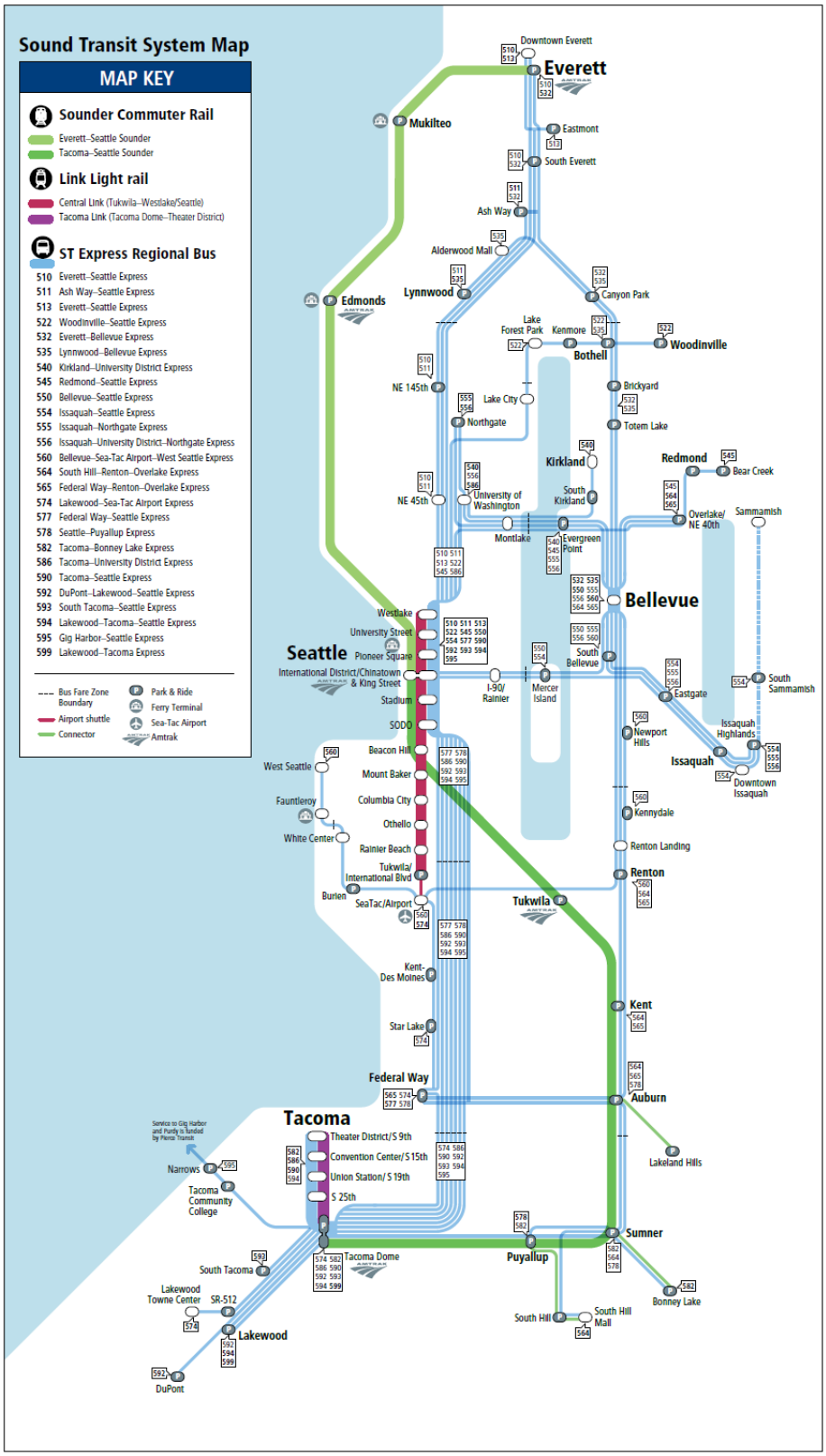

Figure 22: Seattle Sound Transit Rail and Express Bus System

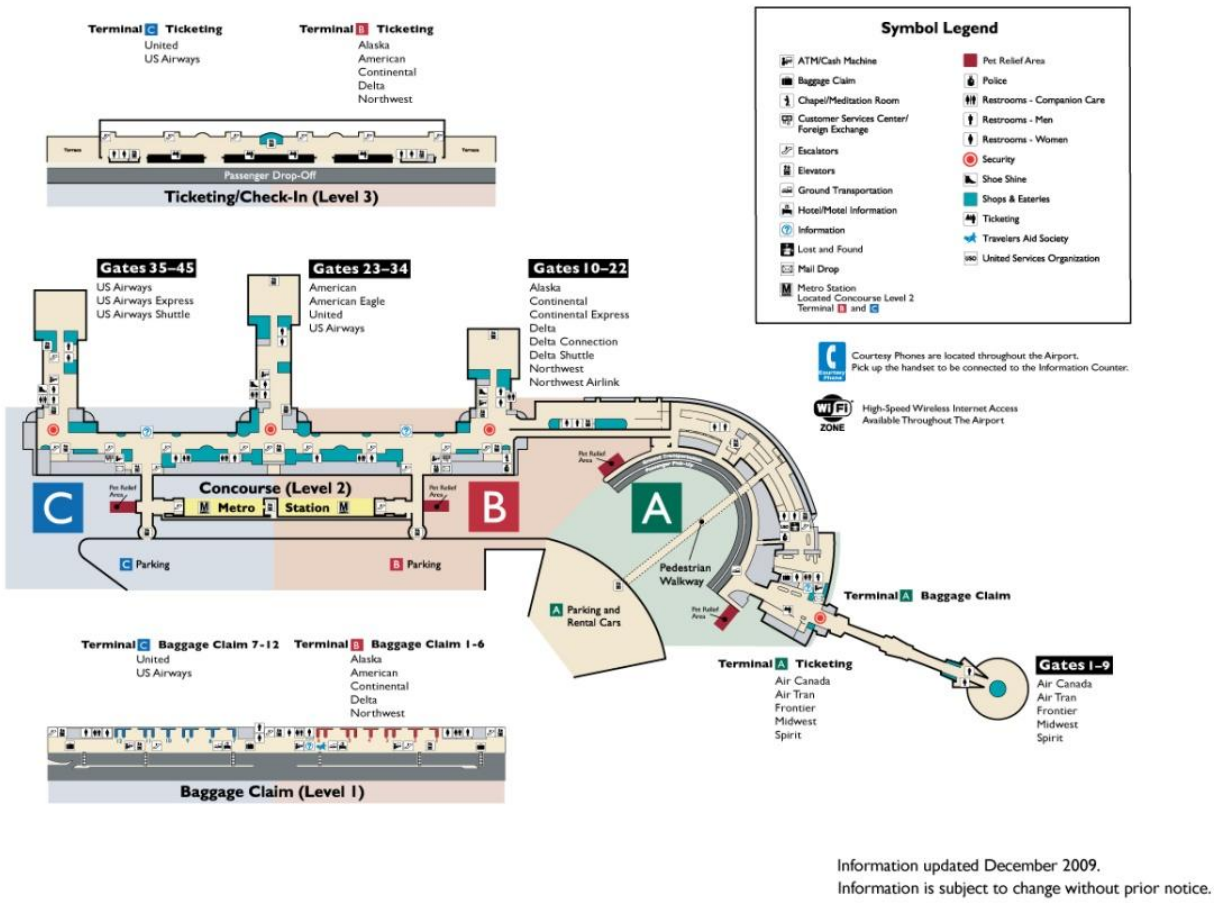

Figure 23: Washington DC Reagan National Airport Metro Rail Transit Station

Figure 24: Washington DC Metro Rail System