MEMPHIS AREA TRANSIT AUTHORITY

PEER REVIEW

May 2011

NELSON
NYGAARD

Table of Contents

List of Figures

CHAPTER 1: INTRODUCTION

As part of the Short Range Transit Planning process, the Nelson\Nygaard team prepared a peer review. The objective of this peer review is to compare and contrast the Memphis Area Transit Authority (MATA)'s services and operating statistics with similarly sized and positioned transit agencies. Through these comparisons, the study team will be able to better understand MATA's strengths and weaknesses and uncover opportunities for potential system improvements.

A peer review by design involves comparisons. At the same time, however, we also recognize that every city and transit agency is unique, shaped by different geography, history and development patterns. As a result, unqualified quantitative comparisons between transit agencies are inappropriate. Comparisons between agencies are, at best, indicators – few hard and fast comparisons can be made because of the myriad of differences between agencies and operating environments. In spite of these limitations, peer reviews can and do provide valuable insight into agency operations, so long as these limitations are respected. The intent of this analysis, therefore, is to gauge MATA's public transportation system's successes and opportunities and identify aspects of the system warranting further investigation.

Methodology and Evaluation Criteria

To identify and select peer cities and transit agencies, Nelson\Nygaard and MATA staff developed a long list of potential peers, inclusive of the cities deemed comparable by MATA staff, the Memphis Chamber's peer cities list, and the peer cities list from the project Request for Proposals. Through discussions with MATA staff and analysis of a number of factors including service area, population, poverty rates, density and the modes of transit operated, ten comparable peer systems were selected. A map showing the location of the peer cities is included as Figure 1.

Nelson\Nygaard compared and contrasted the peer agencies according to a series of qualitative and quantitative measures. Our qualitative review included looking at strategies used by other agencies to attract and maintain riders; examining how peer agencies structured and organized their service network; and reviewing how agencies have successfully used transit technology and intelligent transportation systems. Sources for the background profiles on individual cities and transit systems and qualitative measures include information from agency websites, conversations with agency staff, and Nelson\Nygaard experience with the individual systems.

Figure 1 Peer Transit System Cities

A second key part of the peer review was the quantitative analysis. This process looked at industry statistics about transit usage, performance and efficiency. The intent behind this analysis is to understand how MATA performs against its peers and identify areas needing improvement. The primary quantitative measurements we used to compare agency service included:

- **Transit Density** defined as vehicle service hours per square mile. This measure compares regional service coverage.
- **Transit Usage** expressed in terms of the number of unlinked passenger trips per capita, this measure indicates usage of the transit services in the region.
- **Service Productivity** is considered in terms of ridership per unit of service provided. Two measures are included: the number of unlinked passenger trips per vehicle revenue hour and the number of passenger miles per revenue vehicle hour.

- **Service Efficiency** is defined as the total vehicle hours divided by revenue vehicle hours. This ratio allows comparison of the relative operational efficiency of vehicle deployment and scheduling.
- **Cost Efficiency** expressed as operating cost per revenue vehicle hour. It is used to compare operating costs per hour of service.
- **Cost Effectiveness** considered in terms of operating costs per passenger trip, measures costs in terms of the number of passengers carried. Operating costs per passenger mile is also included as a cost effectiveness measure. This measure gauges costs in terms of the distance passengers are carried.
- **Subsidy per Passenger Trip** is measured as costs per passenger trip, net of fare revenue. This measure shows the amount of non-revenue (public) resources required to account for the full costs associated with each passenger trip.

The primary source for these quantitative measures was data and statistics reported in the 2009 National Transit Database (NTD). Using NTD data ensures that the data reflects a consistent measurement system. System wide measures reported in Chapter 5 consider transit use and cost based on all modes, including fixed-route bus service, light rail, trolley, and demand response service.

Memphis and the Memphis Area Transit Authority

At the time of this peer review, MATA operates four types of service:

- **Fixed-Route Bus** – there are 34 fixed bus routes. MATA operates one express route, called a Blazer that connects southeast Memphis with downtown and one route that has one express trip in each peak period that connects northeast Memphis with downtown.
- **Trolley** – MATA operates three trolley lines on 10 route miles of rail track. The trolley service is operated with vintage trolleys and the service functions as a downtown circulation system for workers, residents, and visitors.
- **Special Event Shuttle Service** – MATA provides shuttle service to special events scheduled at the FedEx Forum and Liberty Bowl Memorial Stadium.
- **MATA*plus*** – MATA's paratransit service offers door-to-door transportation for those with a disability that prevents them from using MATA's fixed-route services.

MATA services are roughly organized around a radial system, but operate with three transit hubs, two downtown (North End Terminal and Central Station) and one in the southeast part of the service area (American Way Transit Center). A fourth transit hub (Airways Transit Center) is under construction and will be located on the west side of the airport. In addition, the system has five cross-town routes that are loosely laid on top of the radial services to provide opportunities for transfers outside of downtown.

The regular adult cash fare on MATA bus service is $1.50. Unlimited ride passes are available for 1-day, 7-day, and 31-day periods at costs of $3.25, $15, and $50, respectively. Transfers are charged a full fare at each boarding. The trolley service adult fare is $1.00 (or $1.50 with a transfer to local bus). A reduced Lunch Fare on the trolley of $0.50 is offered from 11 AM to 1:30 PM on weekdays. The same 1-day, 7-day, and 31-day unlimited ride passes that are available on fixed route are also available on trolley, plus a 3-day pass that can be used on the trolley system only. The base fare on MATA*plus* is $3.00.

Organization of the Peer Review

The peer review is organized around three chapters that follow this introductory chapter. The second chapter presents a descriptive overview of MATA and each of the ten peer agencies. For each agency, we provide an overview of their system development as well as service design, service hierarchy and fare structure. The third chapter reports on the qualitative measures and the fourth chapter compares and contrasts the peer agencies based on the quantitative performance measures. Finally, the last chapter identifies the lessons learned from the peer agencies and potential applications for MATA.

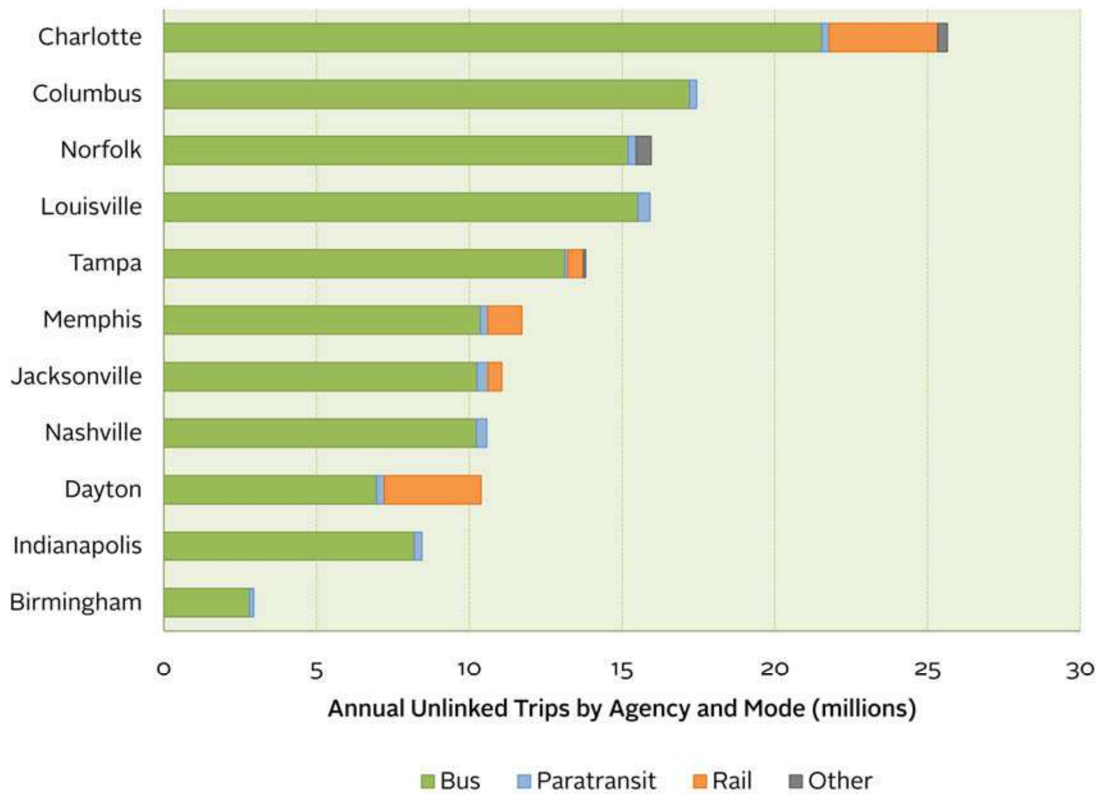
CHAPTER 2: PEER OVERVIEW

As previously discussed, MATA staff and the Nelson\Nygaard team identified a list of ten transit agencies to be used as peers for comparison with MATA. These agencies were selected based on a screening analysis that considered service area, population, density, poverty rates, geographical proximity to MATA, and other system characteristics. The peer agencies are:

- Jacksonville Transportation Authority in Jacksonville, Florida
- Hillsborough Area Regional Transit Authority in Tampa, Florida
- Transit Authority of River City in Louisville, Kentucky
- Indianapolis Public Transportation Corporation in Indianapolis, Indiana
- Hampton Roads Transit in Norfolk, Virginia
- Charlotte Area Transit System in Charlotte, North Carolina
- Greater Dayton Regional Transit Authority in Dayton, Ohio
- Metropolitan Transit Authority in Nashville, Tennessee
- Birmingham-Jefferson County Transit Authority in Birmingham, Alabama
- Central Ohio Transit Authority in Columbus, Ohio

Each peer system shares characteristics with Memphis. All of the peer agencies operate in eastern cities (east of the Mississippi) and have a relatively similar service area population (Norfolk, Dayton, and Nashville have dissimilar service area populations, but are otherwise relevant peers so they have been included). Peer systems, like MATA, are also predominately bus systems. Figure 2 shows that five of the ten peer systems operate a combination of fixed-route bus and some type of rail service (including trolleys, automated guideway transit, light rail, or commuter rail), but all ten are predominantly bus operations. This figure also shows that MATA is in the middle amongst its peers in terms of the number of passenger trips.

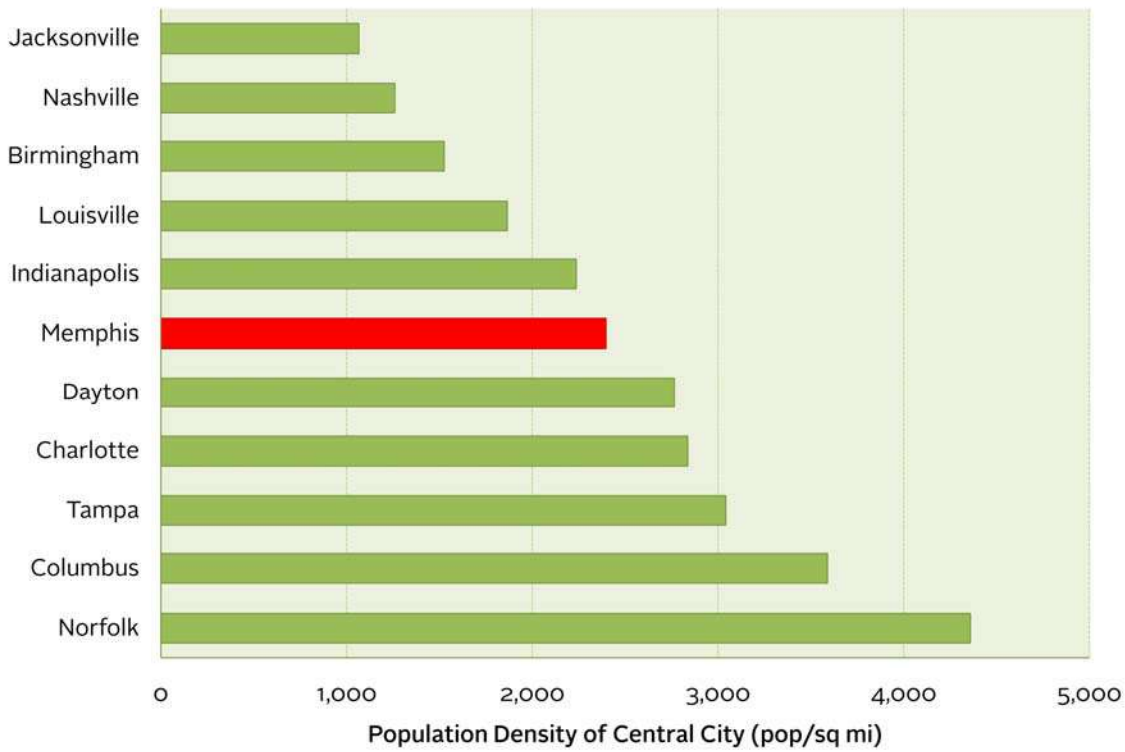
Figure 2 Passengers Carried by Peer and Mode



Source: 2009 National Transit Database (NTD).

The peer agencies also operate in cities that are roughly the same size. MATA has a service area population of 888,627, which is comparable with the majority of the peer systems (see Figure 4). Three agencies serve dissimilar populations but were otherwise deemed to be relevant peers — Hampton Roads Transit in Norfolk, serving 1.2 million, Greater Dayton Regional Transit Authority in Dayton, serving 559,062, and Metropolitan Transit Authority in Nashville, serving 573,294. Since population density often impacts public transit service, we also made sure the peer agencies operated in cities that had comparable population density (as compared with the density of the service area itself because the service areas often changes considerably over space, which skews the overall density). The population densities among the peer group vary from about 1,000 people per square mile to about 4,500 people per square mile. Memphis is about average, with 2,397 people per square mile (see Figure 3). The two peers with the highest population density (and similarly high populations) — Norfolk and Columbus — also have high service levels.

Figure 3 Population Density of Peer Cities



Source: 2009 National Transit Database (NTD).

A summary table of descriptive information on each peer city and transit system, including MATA, is shown in Figure 4.

Figure 4 Overview of Peer Communities and Transit Agencies

	Memphis, TN	Jacksonville, FL	Tampa, FL	Louisville, KY	Indianapolis, IN	Norfolk, VA	Charlotte, NC	Dayton, OH	Nashville, TN	Birmingham, AL	Columbus, OH	Peer Average
Transit Provider	Memphis Area Transit Authority	Jacksonville Transportation Authority	Hillsborough Area Regional Transit Authority	Transit Authority of River City	Indianapolis Public Transportation Corporation	Hampton Roads Transit	Charlotte Area Transit System	Greater Dayton Regional Transit	Metropolitan Transit Authority	Birmingham-Jefferson County Transit Authority	Central Ohio Transit Authority	
Service Area Definition	1 county plus 1 adjacent city	1 county	1 county	1 metropolitan area	1 county	7 cities	1 metropolitan area	2 counties	1 county	1 county	1 county plus portions of 4 others	
Service Area Size (sq mi)	288	242	243	283	373	369	445	274	484	186	325	319
Service Area Population (thousands)	888.6	827.5	821.3	754.8	791.9	1,210.6	758.9	559.1	573.3	662.0	1,057.9	810
Service Area Population Density (ppl/sq mi)	3,086	3,419	3,380	2,667	2,123	3,281	1,705	2,040	1,184	3,559	3,255	2,700
City Population Density (ppl/sq mi)	2,397	1,066	3,042	1,866	2,237	4,359	2,838	2,765	1,260	1,526	3,590	2,450
Adult Cash Fare	$1.50	$1.00	$1.75	$1.50	$1.75	$1.50	$1.75	$1.75	$1.60	$1.25	$1.75	$1.55
Modes Operated	3	3	4	2	2	4	4	3	2	2	2	
Number of Bus Routes	35	56	47	46	28	81	68	32	42	32	67	49
Vehicles Operated in Maximum Service (Bus)	135	162	159	205	142	290	286	95	108	71	235	172
Route Miles of Rail	10.0	5.4	4.8	-	-	7.0	19.0	-	32.0	-	-	13
Poverty Rate (city)	25%	14%	18%	17%	18%	17%	13%	30%	17%	25%	21%	20%

Source: All data from the 2009 National Transit Database (NTD).

Notes: 1) Nashville commuter rail is operated by MTA in cooperation with the Regional Transportation Authority; 2) Norfolk light rail is under construction.

Jacksonville Transportation Authority in Jacksonville, Florida

The city of Jacksonville sits on Florida's northern Atlantic coast on the banks of the St. Johns River, which runs through the middle of the city. Jacksonville is Florida's most populous city with a population of 813,518 people; it is also the largest city by size in the continental United States, covering 885 square miles.[1] Jacksonville has a metropolitan area population of 882,295. Jacksonville's large geographic area contributes to a low population density, making transit less attractive relative to other transportation modes, especially the private automobile. Consequently, Jacksonville Transit Authority (JTA)'s services are less effective as compared to some of the peers (see discussion in Chapter 4). JTA has a service area population of 827,453.

The JTA offers fixed-route bus (local and express), rubber tire trolley, aerial automated guideway (the Skyway), stadium shuttle, and paratransit services. The system is designed as a radial system (see Figure 5), with many routes originating downtown and radiating outwards on both sides of the St Johns River. Cross-town trips usually involve a trip downtown to transfer to another route. JTA service in includes:

- **Fixed-Route Bus** – consists of 56 routes including local routes, as well as flyer and express routes which offer limited or non-stop service. They also market interliner routes, which eliminate the necessity to transfer.
- **Trolley** – four bus routes are marketed as trolley lines (they are actually diesel powered buses with a historic trolleybus style design): two downtown circulators (the Bay Street Trolley and the Beaver Street Trolley), one offering service between Atlantic Beach, Neptune Beach and Jacksonville Beach (the Beaches Trolley), and one which links downtown to the Riverside/Avondale community (the Riverside Trolley).
- **Skyway** – a 2.5-mile aerial automated guideway system with 8 stations in the central business district. The fully automated system operates with nine 2-car trains.
- **Stadium Shuttle** – offers service from various downtown and suburban park and ride stations to EverBank Field before and after sporting events.
- **Connexion** – JTA oversees paratransit services within three-quarter miles of bus and Skyway lines in Duval County.

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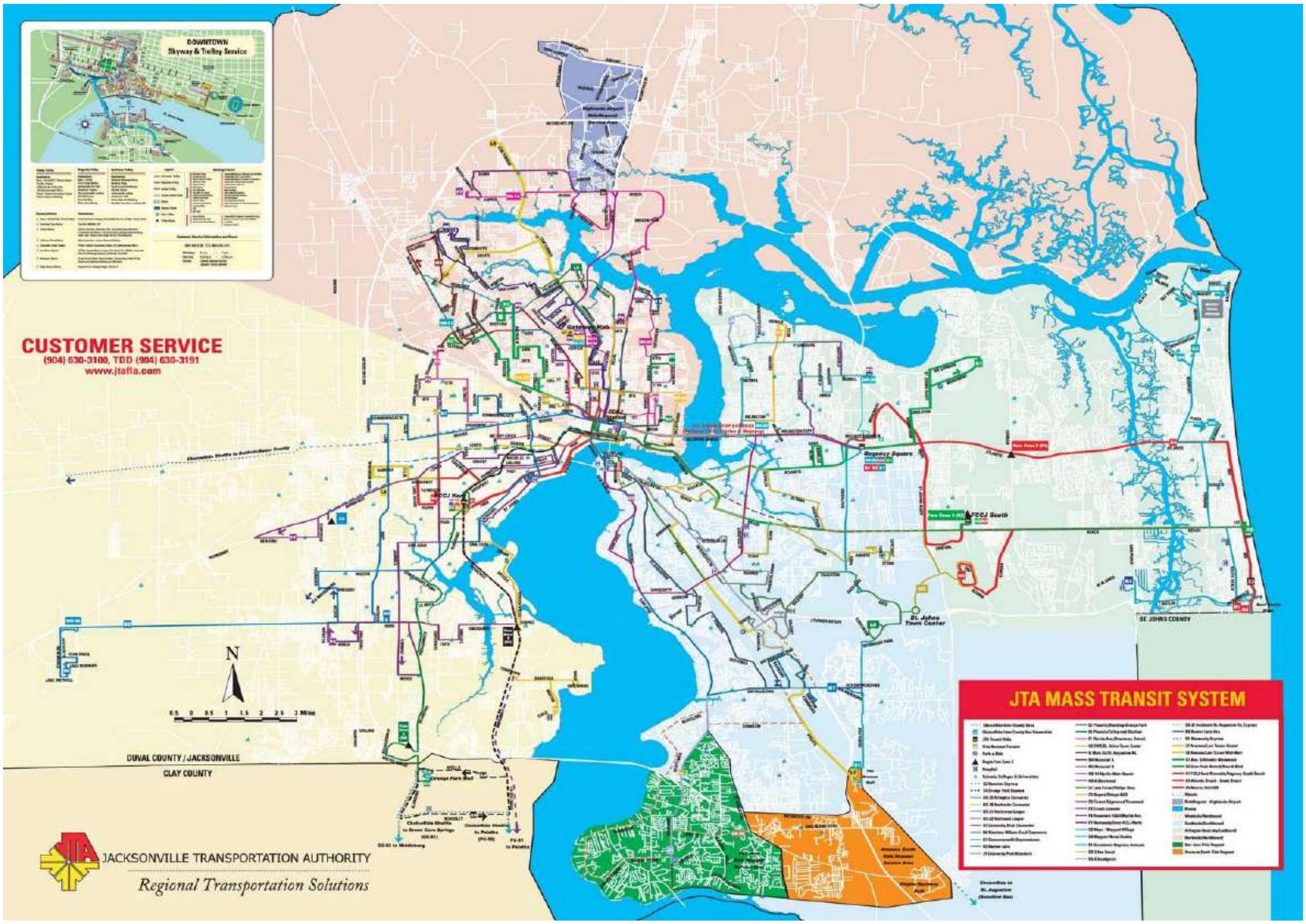
[1] Jacksonville population from U.S. Census Bureau, 2009 Population Estimate.

The adult cash fare for local bus is $1.00, or $40 for a monthly pass, while the express bus fare is $1.50. The Skyway fare is $0.50 or $20 for a monthly pass. The trolley fare is $1.00, except for the two downtown circulator trolleys, which are free. Transfers are not included in the fare.

Figure 5 Jacksonville Transit Authority System Map



Hillsborough Area Regional Transit Authority in Tampa, Florida

Tampa is a city of approximately 343,890 residents situated on Florida's gulf coast.[2] Tampa is on Tampa Bay just to the east of St. Petersburg, a more populous city served by a separate transit district (though both cities share the same metropolitan area of just over 2 million people). The Hillsborough Area Regional Transit Authority (HART) provides transit service to Tampa and Hillsborough County, with a service area population of 821,306.

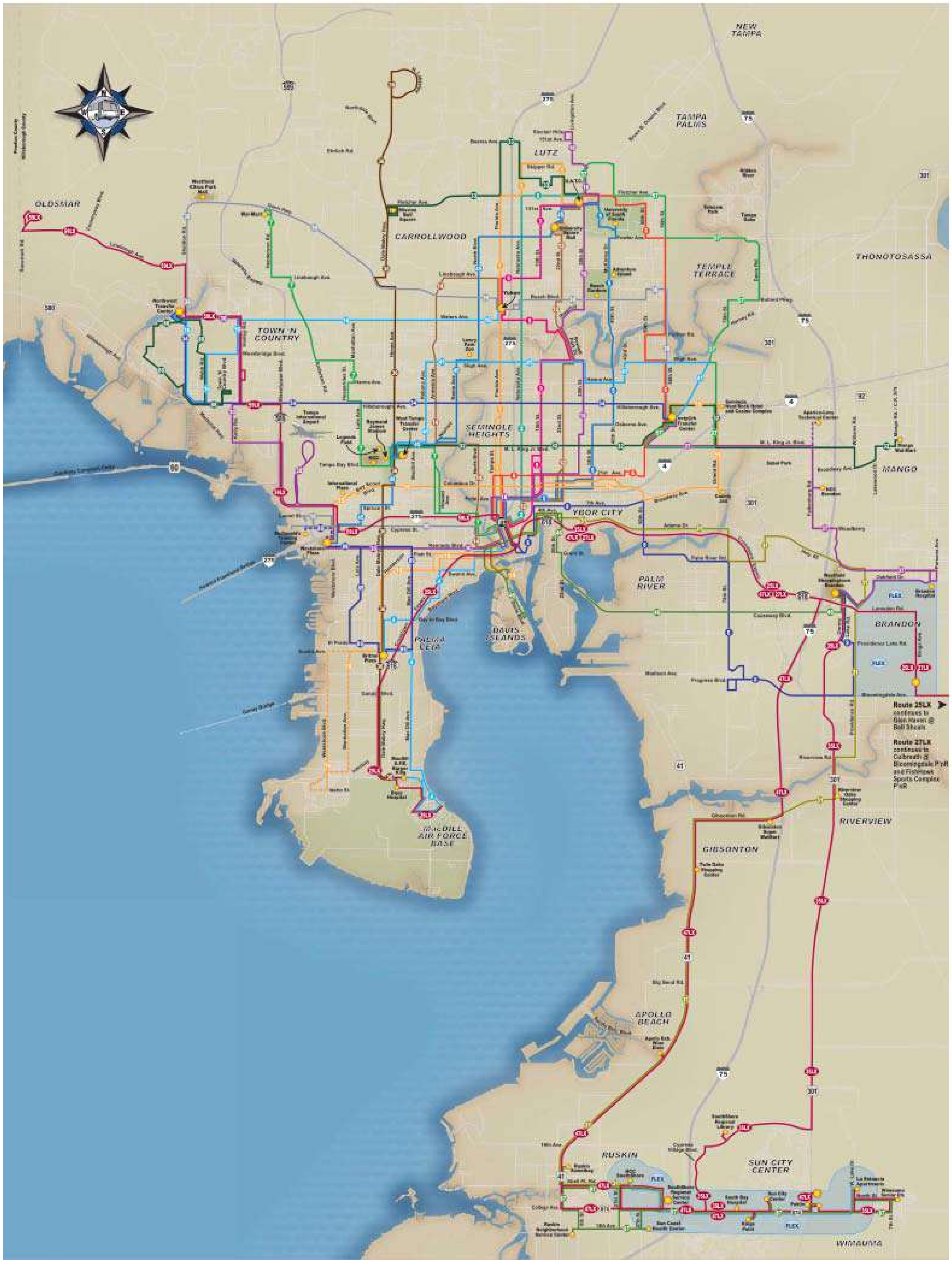
HART is designed as a hybrid hub-and-centers system that operates with a grid-like pattern (see Figure 6). Most routes converge downtown at the system's main transit hub, Marion Station. There are two other staffed transit centers (one downtown and one in northern Tampa) and nine unstaffed transfer centers at dispersed locations throughout the service area that act as transfer hubs. Plus, nearly all of the system's routes form a grid-like pattern, which eases transfers throughout the service area. A few routes do not contribute to the grid, namely the routes heading south towards the communities of Ruskin, Sun City Center, and Wimauma. HART offers the following transit services:

- **Fixed-Route Bus** – consists of 32 local bus routes. Two routes are branded as In-Town trolleys (actually rubber-tire stylized buses) and 13 routes are express service.
- **TECO Line Streetcar** – a 2.7 mile long streetcar system with 11 stations, which is operated by Tampa Historic Streetcar, Inc.
- **HARTFlex** – consists of two relatively new flexible route services where the driver provides door-to-door service on an advanced reservation basis, though flag-downs are also possible. This service is open to everyone.
- **HARTPlus** – HART oversees paratransit services within three-quarter miles of bus lines in Hillsborough County.

The adult cash fare for local bus is $1.75 or $60 for a monthly pass. The express bus fare is $2.75 or $90 for a monthly pass. Transfers are not included in the fare. Two neighborhood connector routes charge a reduced fare of $0.50, and the In-Town trolley charges $0.25. A contract between the University of South Florida and HART allows students to ride free. The TECO Line Streetcar fare is $2.50. HARTFlex service is $0.85.

[2] Tampa population from U.S. Census Bureau, 2009 Population Estimate.

Figure 6 Hillsborough Area Transit Authority System Map


NEW TAMPA
TAMPA PALMS
LUTZ
OLDSMAR
CARROLLWOOD
TEMPLE TERRACE
THONOTOSASSA
TOWN 'N COUNTRY
SEMINOLE HEIGHTS
MANGO
YBOR CITY
PALM RIVER
BRANDON
DAVIS ISLANDS
MACDILL AIR FORCE BASE
RIVERVIEW
GIBSONTON
APOLLO BEACH
RUSKIN
SUN CITY CENTER
WIMAUMA

Transit Authority of River City in Louisville, Kentucky

Louisville, often called the northernmost southern city, is situated on the southern side of the Ohio River (which forms the border between Kentucky and Indiana). It is the most populous city in the Commonwealth of Kentucky with an estimated 754,800 residents. The metropolitan area includes slightly more people, at 863,582. Like Memphis, Louisville is a major freight hub — Memphis has FedEx SuperHub while Louisville has UPS Worldport. The city and county operate under a consolidated government, established in 2003.

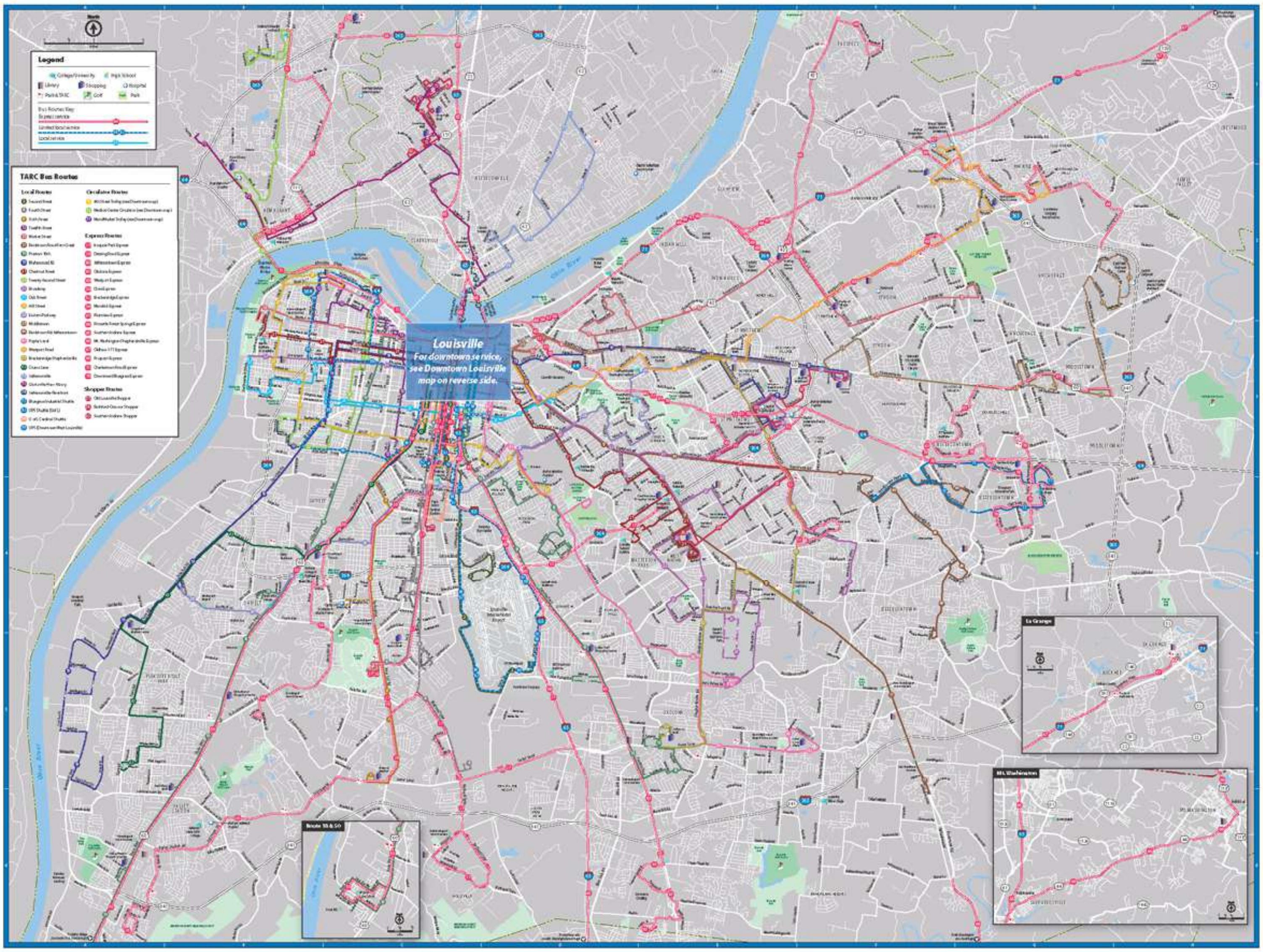
Public transportation services for the Louisville Metropolitan Statistical Area, which includes some parts of southern Indiana across the Ohio River, are provided by Transit Authority of River City (TARC). TARC offers fixed-route bus service and paratransit service called TARC 3. Two bus routes are marketed as trolley services, using diesel powered rubber tire buses with a historic trolleybus-style design. TARC has a service area population of 754,756.

TARC's bus routes are laid out according to a radial system (see Figure 7) on the south side of the Ohio River. The agency studied the feasibility of converting the South Central corridor to light rail, but the project has been canceled due to the inability to secure local funding. Louisville is one of four peer cities (along with Nashville, Columbus, and Dayton) with no passenger rail service such as Amtrak. Transit services offered by TARC include:

- **Fixed-Route Bus** – TARC's fixed-route bus service includes 26 local routes, 14 express routes, 2 trolley routes (not technically trolleys because they are diesel powered rubber tire buses), and 4 shuttle routes for a total of 46 routes.
- **TARC 3** – TARC also provides ADA complementary paratransit services to customers unable to use fixed-route services using a fleet of vans.

The adult cash fare is $1.50 or $42 for a monthly pass. The cash fare for express routes is $2.50, or $80 for a monthly pass. The trolley services are currently free (though this has historically varied depending on funding). University of Louisville students ride free as part of an agreement between the university and TARC.

Figure 7 Transit Authority of River City System Map



Indianapolis Public Transportation Corporation in Indianapolis, Indiana

Indianapolis is a located along the White River in central Indiana and has a population of 807,584.[3] The metropolitan area is home to 1,218,919 people. Indianapolis is the state capital of Indiana and the third most populous city in the Midwest region of the United States. The city and county operate under a consolidated government.

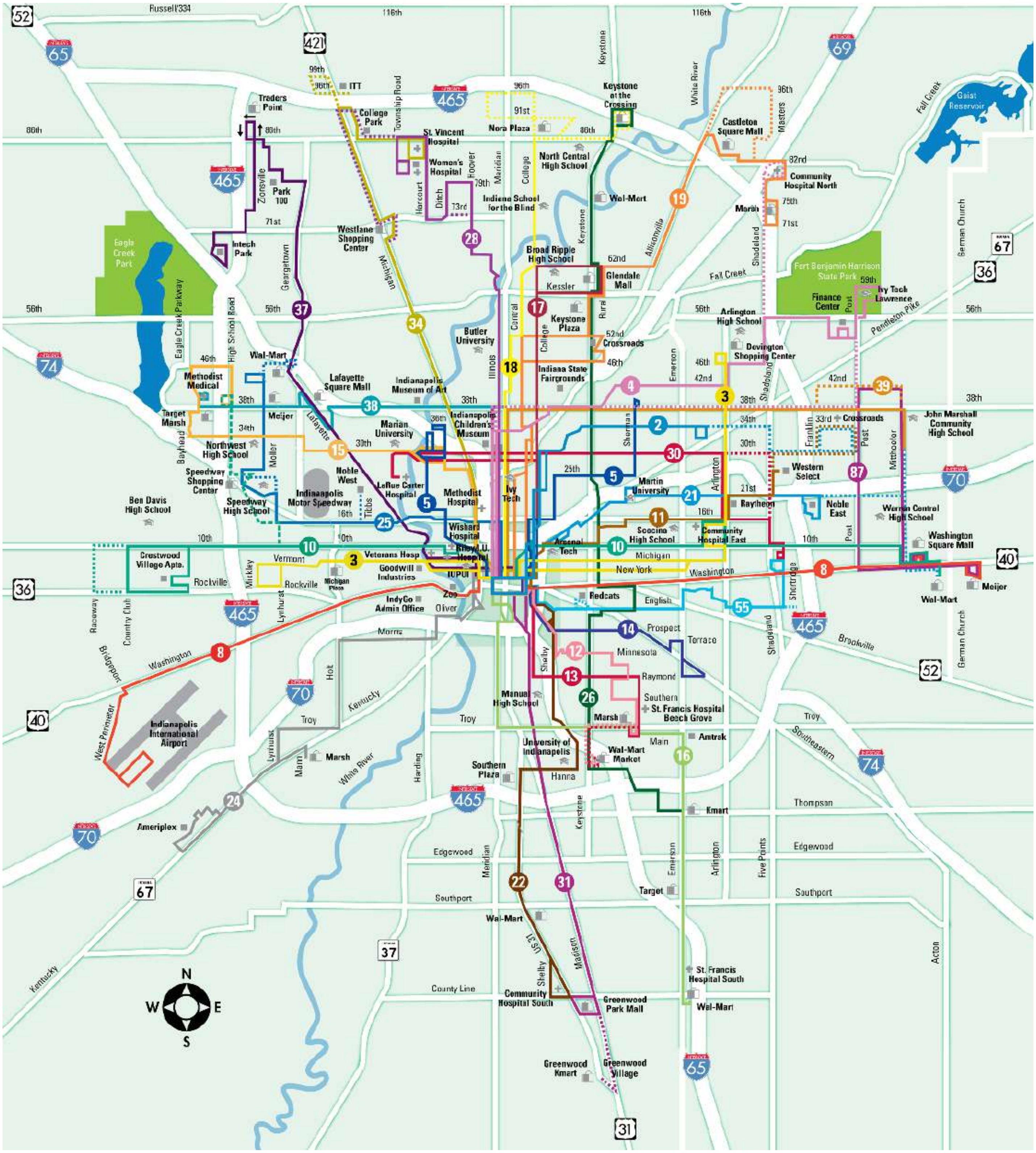
Indianapolis is a low density area and similar to other cities with low population density, it has relatively low traffic congestion levels and has not made significant investments in transit services. Transit services are operated by the Indianapolis Public Transportation Corporation (IndyGo), which maintains a network of fixed-route bus and paratransit service. IndyGo has a service area population of 791,926. The bus network is a combination of radial and grid concepts (see Figure 8) — routes radiate out of the central business district to serve outlying areas but also take on a grid pattern. IndyGo offers the following transit modes:

- **Fixed-Route Bus** - IndyGo operates 31 fixed-routes, including the Green Line downtown-airport express route and the Red Line downtown circulator.
- **Open Door** – IndyGo also provides ADA complementary paratransit services to customers unable to use fixed-route services using a fleet of small buses. This service is contracted out.

The adult cash fare (including the red line circulator) is $1.75 or $60 for a monthly pass. The Green Line airport express fare is $7. Transfers are not included in the fare.

[3] Indianapolis population from U.S. Census Bureau, 2009 Population Estimate.

Figure 8 IndyGo System Map


Russell'334
116th
96th
91st
Nora Plaza
86th
Keystone at the Crossing
Castleton Square Mall
Traders Point
College Park
St. Vincent Hospital
Women's Hospital
North Central High School
Indiana School for the Blind
Wal-Mart
Community Hospital North
Westlane Shopping Center
Intech Park
Park 100
Broad Ripple High School
Glendale Mall
Eagle Creek Park
Fort Benjamin Harrison State Park
Ivy Tech Lawrence
Finance Center
Arlington High School
Keystone Plaza
Butler University
52nd Crossroads
Devington Shopping Center
Methodist Medical
Wal-Mart
Lafayette Square Mall
Indianapolis Museum of Art
Indiana State Fairgrounds
Target Marsh
Meijer
Marian University
Indianapolis Children's Museum
Crossroads
John Marshall Community High School
Northwest High School
Western Select
Speedway Shopping Center
Noble West
LaRue Carter Hospital
Methodist Hospital
Ivy Tech
Martin University
Ben Davis High School
Speedway High School
Indianapolis Motor Speedway
Raytheon
Noble East
Warren Central High School
Wishard Hospital
Scecina High School
Community Hospital East
Washington Square Mall
Crestwood Village Apts.
Veterans Hosp
Arsenal Tech
Goodwill Industries
IUPUI
Zoo
Redcats
Meijer
IndyGo Admin Office
Wal-Mart
Indianapolis International Airport
Manual High School
St. Francis Hospital Beech Grove
Marsh
Amtrak
University of Indianapolis
Wal-Mart Market
Southern Plaza
Ameriplex
Kmart
Target
Wal-Mart
St. Francis Hospital South
Community Hospital South
Greenwood Park Mall
Wal-Mart
Greenwood Kmart
Greenwood Village
N
W
E
S

Hampton Roads Transit in Norfolk, Virginia

Norfolk is part of the Hampton Roads area, a part of southeastern Virginia that includes other cities such as Virginia Beach and Hampton. The region has a unique geography— the numerous natural bays and deep water inlets have made this area an important military and freight shipping port. While Norfolk is considered the central business district and the financial and cultural center of the area, neighboring Virginia Beach is the most populous city (though it actually functions more like a suburb of Norfolk). While the city of Norfolk itself has a population of 233,333, the population of the service area is much higher — highest amongst the peers — at 1.2 million.[4] The population density of both Norfolk and the service area as a whole are both high as well, which has resulted in a high transit density.

Public transportation services in the Hampton Roads area are provided by Hampton Roads Transit (HRT). HRT has a service area population of 1,210,588. The complicated geography of the service area, which spans both sides of the bay and serves seven independent municipalities, influences the service development and design. HRT was formed in 1999 from the merger of two agencies, the Peninsula Transportation District Commission and the Tidewater Regional Transit into a single regional entity. Consequently, the transit service design is polycentric, focused around connecting the multiple activity centers and cores throughout the seven cities and bridging the gap created by the various water bodies (see Figure 9). As such, the bus network is comprised of multiple core transfer centers scattered throughout the service area, with interconnecting routes between them. HRT offers fixed-route bus, ferry, and paratransit services. A 7.4-mile light rail line is scheduled to open in 2011. HRT transit services are:

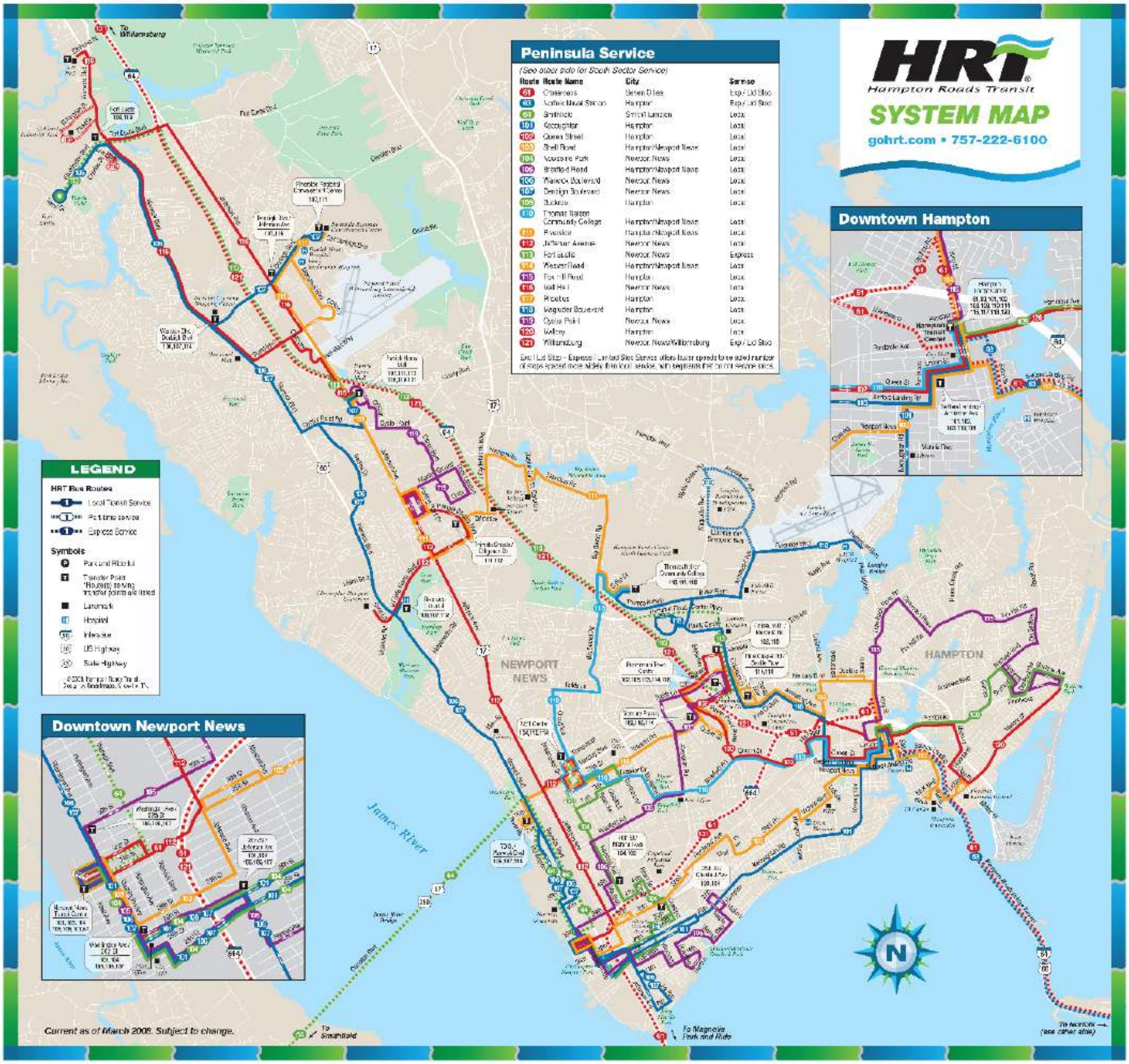
- **Fixed-route Bus** – there are a 81 fixed-route regular bus routes.
- **MAX** - (Metro Area Express) 7 express routes.
- **VB Wave** – 3 circulator routes serving Virginia Beach.
- **Portsmouth Loop** - 2 circulator routes serving the Portsmouth downtown.
- **NET** - one downtown Norfolk Circulator (Norfolk Electric Transit), using 29-foot hybrid buses.
- **Paddlewheel Ferry** - one ferry route between Portsmouth and Norfolk.

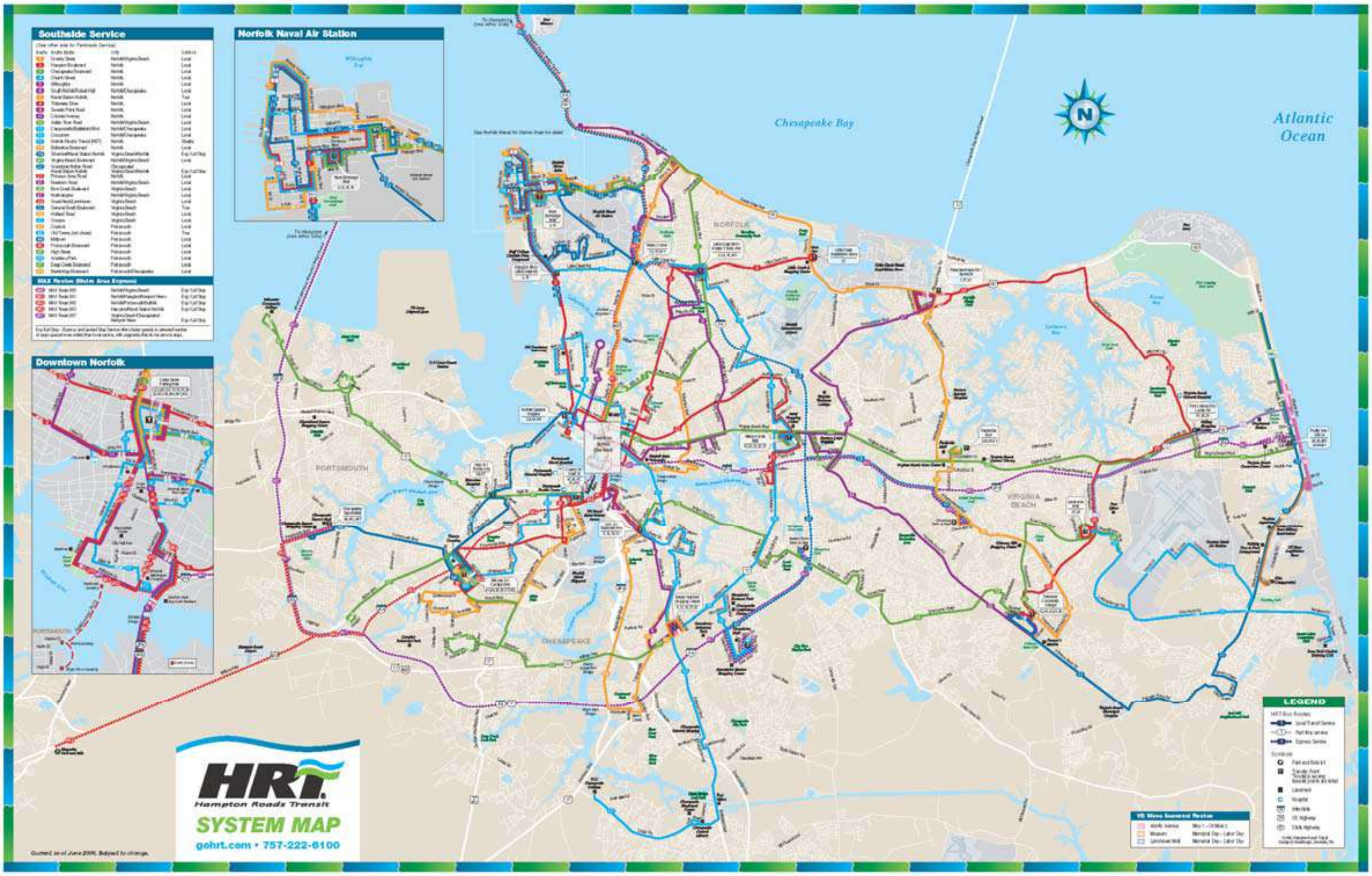
[4] Norfolk population from U.S. Census Bureau, 2009 Population Estimate; service area population from 2009 NTD.

- **HandiRide –** HRT's ADA complementary paratransit service offers door-through-door service to individuals with disabilities.

The adult cash fare for regular fixed-route bus and water ferry services is $1.50 or $50 for a monthly pass. Transfers are not included in the fare. The express bus services have a fare of $3.00 or $95 for a monthly pass. The fare for VB Wave bus routes (serving Virginia Beach) is $1.00. There are downtown circulator services for both Norfolk and Portsmouth, both of which are free.

Figure 9 Hampton Roads Transit System Maps




Southside Service
Norfolk Naval Air Station
Downtown Norfolk
Chesapeake Bay
Atlantic
Ocean
NORFOLK
PORTSMOUTH
VIRGINIA
BEACH
CHESAPEAKE
LEGEND
HRT
Hampton Roads Transit
SYSTEM MAP
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Charlotte Area Transit System in Charlotte, North Carolina

Charlotte is an east coast financial center located near North Carolina's southern border halfway between the Appalachian Mountains and the Atlantic ocean. The city has a population of 704,422 residents and while the service area is of relatively low density, the city itself is moderately dense and supports a range of transit services.[5]

Public transit throughout the metropolitan statistical area is provided by Charlotte Area Transit System (CATS). The population of the metropolitan area and also the service area is 758,927. CATS is the largest system in the peer group, with an operating budget more than twice that of MATA. CATS has good performance statistics— its service bests all of the peers in nearly every one of the system wide performance measures. Charlotte has been a faster growing urban area and has made significant investments in its services for the past several years and consequently, is included here as a benchmark for a successful system.

CATS offers fixed-route bus, light rail, and paratransit service. The bus network takes on a radial service design with a few community transit centers throughout the network which provide an opportunity to transfer at a non-downtown location (see Figure 10). CATS offers the following services:

- **Fixed-route Bus** – CATS operates 49 local bus services and 19 express services.
- **LYNX** – Light rail service operates from uptown to a park and ride station at Interstate 485. The line serves 15 stations.
- **Special Transportation Service (STS) –** CATS offers curb-to-curb paratransit service to eligible individuals within the service area.

The adult cash fare for fixed-route bus and light rail is $1.75 or $70 for a monthly pass. Express routes are either $2.40 or $3.50 for service to neighboring counties. Transfers between local bus routes are free. "Gold Rush" circulator service is free. The light rail line is a proof-of-payment system, where riders purchase their tickets or passes in advance or at ticket vending machines.

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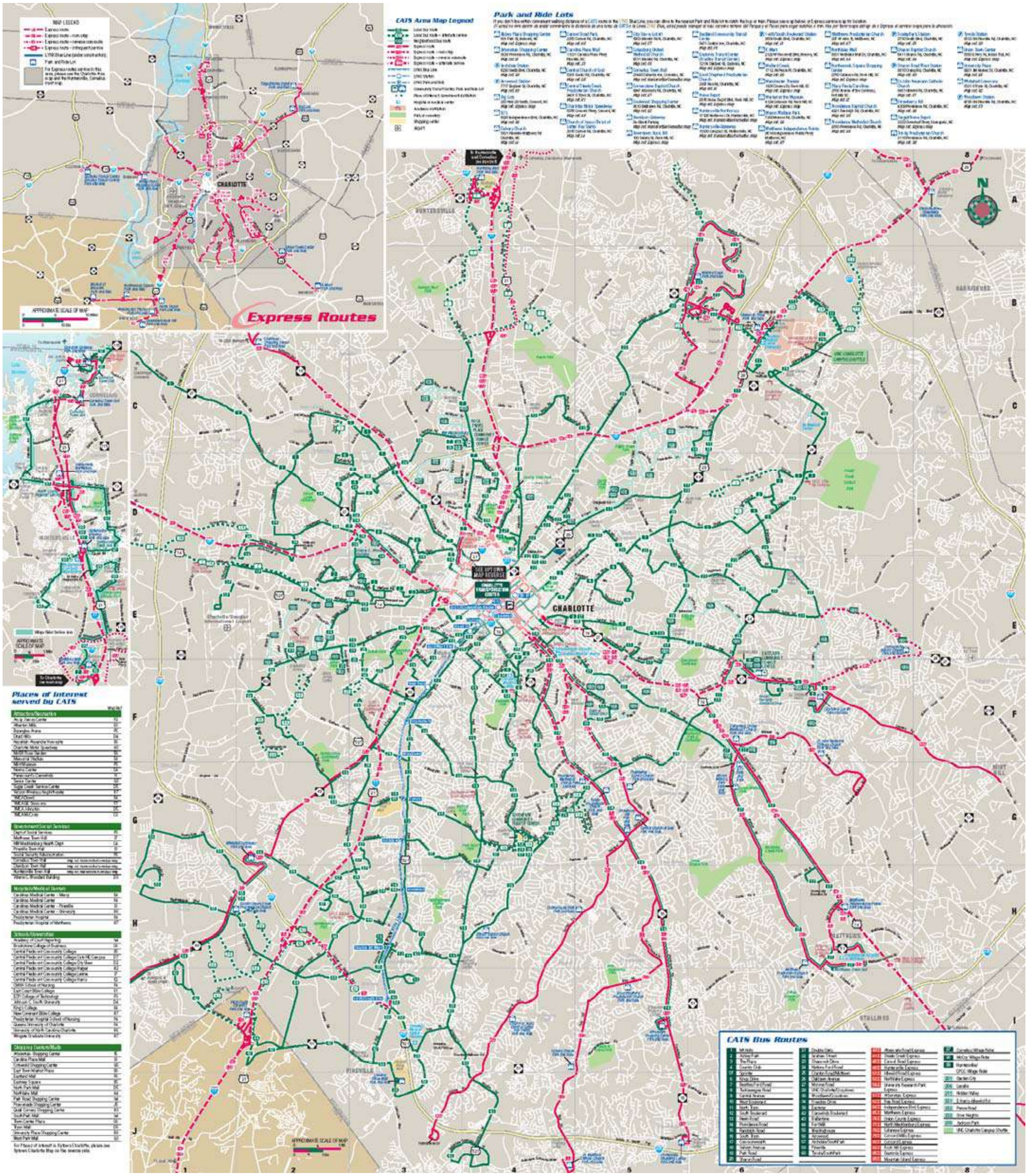
[5] Charlotte population from U.S. Census Bureau, 2009 Population Estimate.

Figure 10 Charlotte Area Transit System Map


Express Routes
Park and Ride Lots
CATS Area Map Legend
Places of Interest served by CATS
CATS Bus Routes
CHARLOTTE

Greater Dayton Regional Transit Authority in Dayton, Ohio

Dayton is a medium size city in western Ohio, with a population of 153,843[6]. The metropolitan area has a population of 703,444. Historically Dayton has been a center of manufacturing, but more recently, the city is transitioning a manufacturing based economy to a more diversified economy with more jobs associated with education, services and healthcare. Consistent with the ongoing transition, Dayton has a relatively high poverty rate of 30%, which is the highest poverty rate amongst the peer cities.

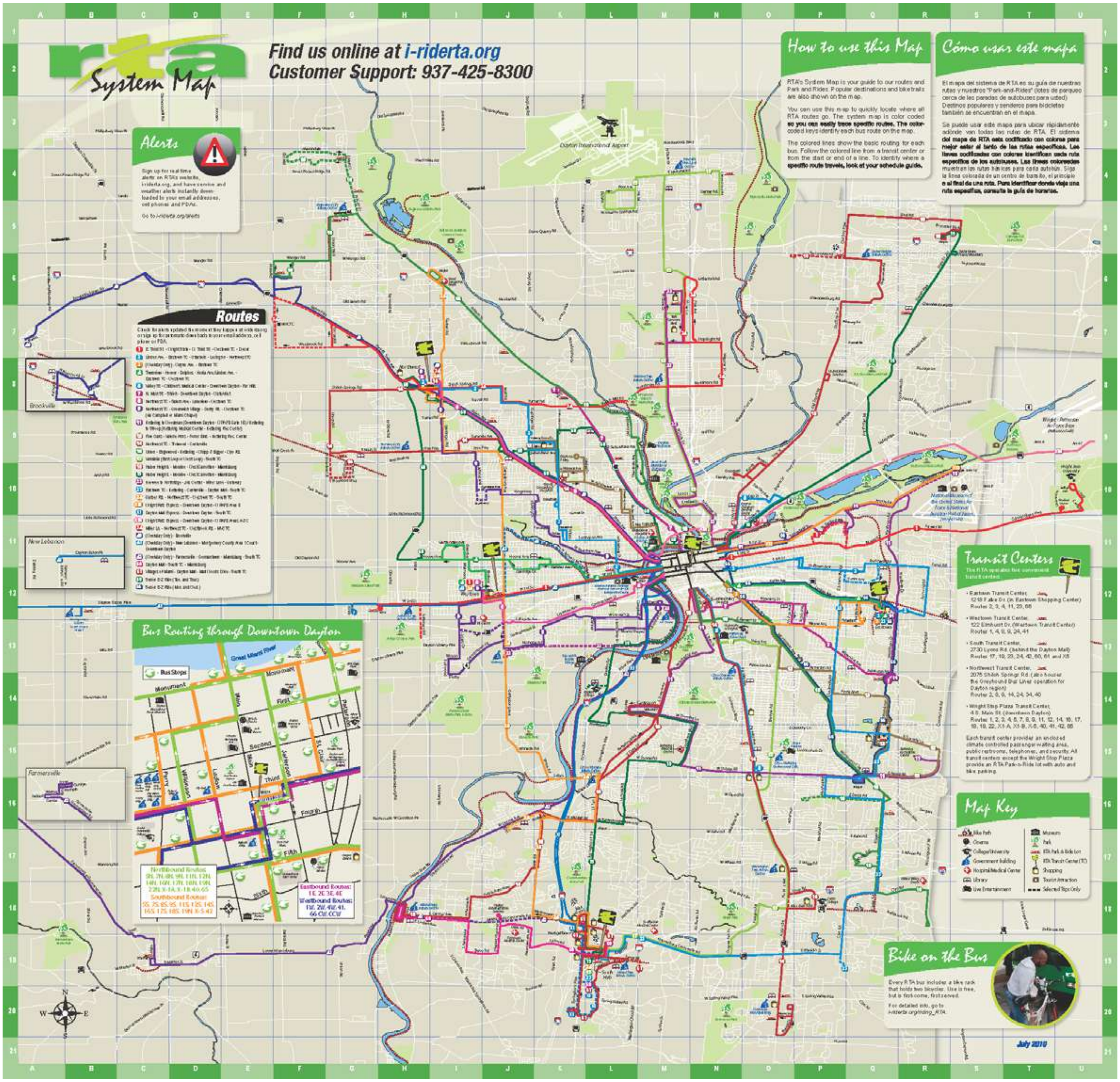
Public transportation in the Dayton metropolitan area is provided by the Greater Dayton Regional Transit Authority (RTA). RTA has a service area population of 559,062. The RTA is known for operating the greenest fleet in Ohio, with environmentally friendly diesel hybrids and electric trolleys. RTA operates a largely radial system with 5 major transit centers throughout the service area offering transfer opportunities at non-downtown locations (see Figure 11). RTA offers the following service:

- **Fixed-Route Bus** – RTA operates 29 regular routes and 3 express routes, including 6 routes that are operated by electric trolley buses.
- **Project Mobility –** RTA's ADA complementary door-to-door paratransit service.

The adult cash fare for fixed-route services, including express routes, is $1.75 or $55 for a monthly pass. Transfers are $0.25, purchased when the initial fare is paid.

[6] Dayton population from U.S. Census Bureau, 2009 Population Estimate

Figure 11 Regional Transit Authority System Map



Metropolitan Transit Authority in Nashville, Tennessee

Nashville is the state capital of Tennessee and operates a city-county consolidated government. Home to 605,473 people, Nashville is Tennessee's second most populous city, after Memphis.[7] The metropolitan area has a population of 749,935. Nashville lies on the Cumberland River and grew as an important shipping and railroad center. While the largest industry in Nashville is healthcare, the city is best known today as the national home of country music.

Public transit in Nashville and Davidson County is provided by the Nashville Metropolitan Transit Authority (MTA). MTA has a service area population of 573,294. The MTA has the largest service area size amongst the peer agencies, at nearly 500 square miles. The MTA is also unique in its focus on downtown and has a strong radial service design— nearly every one of its bus routes serves the downtown transit center, the newly opened Music City Central (see Figure 12). This modern transit center features a climate controlled waiting area, digital signage, a private concession area, and customer information counters. MTA offers the following services:

- **Fixed-Route Bus** – MTA operates 42 bus routes, including 10 express routes. The routes are arranged radially, with most routes serving the downtown transit center and radiating outward.
- **BRT** – MTA's BRT service travels along the Gallatin corridor, the busiest corridor in the service area. The BRT Route 56 is a complementary service to the local Route 26, and offers limited stops, transit signal priority, enhanced stops, simple routing, and headway-based scheduling.
- **AccessRide** – MTA's ADA complementary paratransit service provides door-to-door demand response service for qualified persons with disabilities.

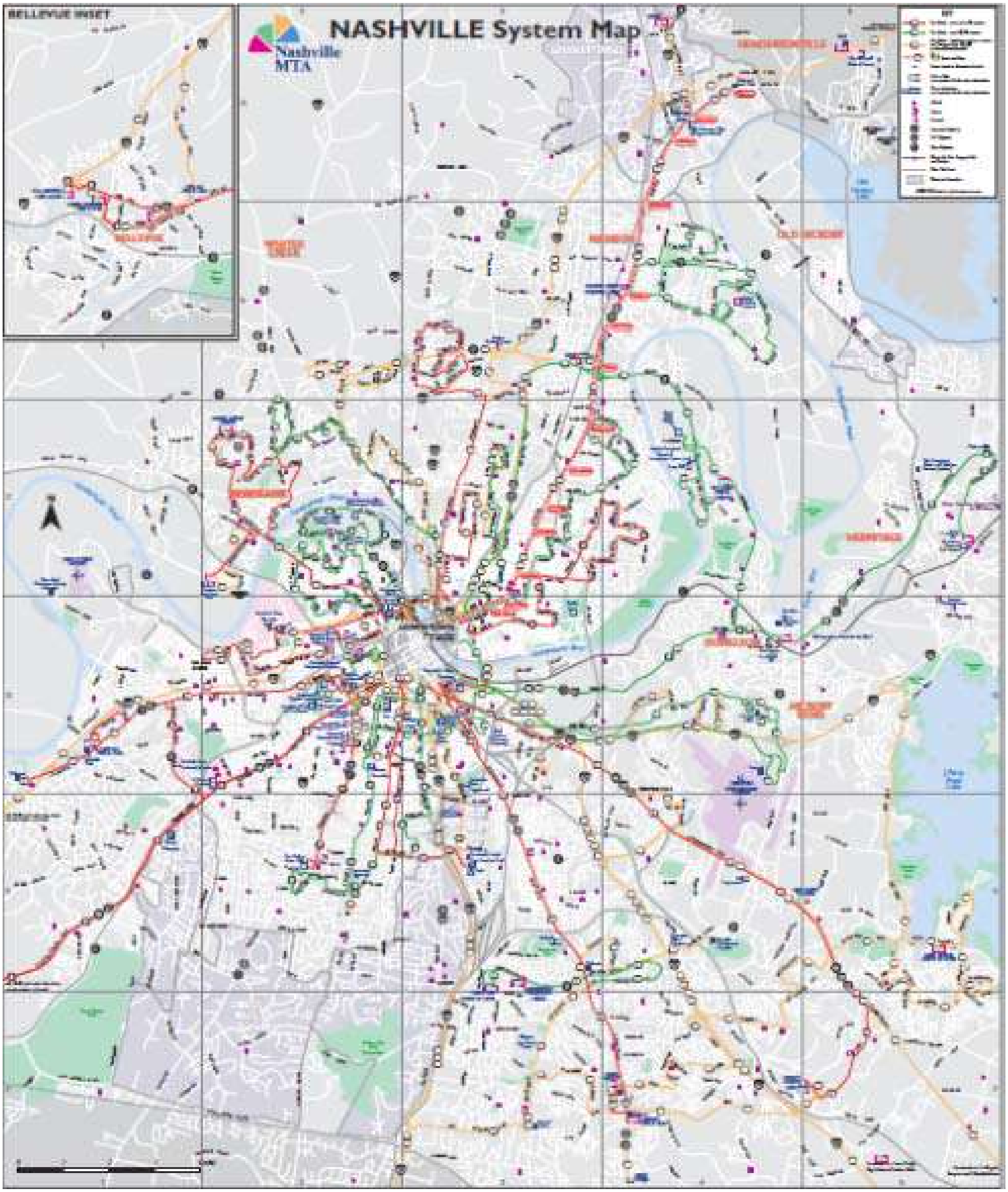
The adult cash fare for fixed-route services, including the BRT Route 56, is $1.60 or $78 for a monthly pass. Transfers are not included in the fare. Express routes charge $2.10. The downtown circulator, Music City Circuit, is free.

In addition to bus services, the MTA, in cooperation with the Regional Transit Authority (RTA) operates a commuter rail service that began in 2006. The Music City Star is a 32-mile single line

[7] Nashville population from U.S. Census Bureau, 2009 Population Estimate.

commuter rail service that operates from Lebanon to Nashville with four intermediate stops (six stops total). The single trip fare is either $2 or $5, depending on travel distance.

Figure 12 Metropolitan Transit Authority System Map


BELLEVUE INSET
NASHVILLE System Map
Nashville MTA

Birmingham-Jefferson County Transit Authority in Birmingham, Alabama

Birmingham is Alabama's most populous city with 230,131 residents,[8] in a metropolitan area of 663,615. The city has historically been an important manufacturing and industrial center for the south. The city is geographically close to Memphis and shares a similarly high poverty rate of 25%.

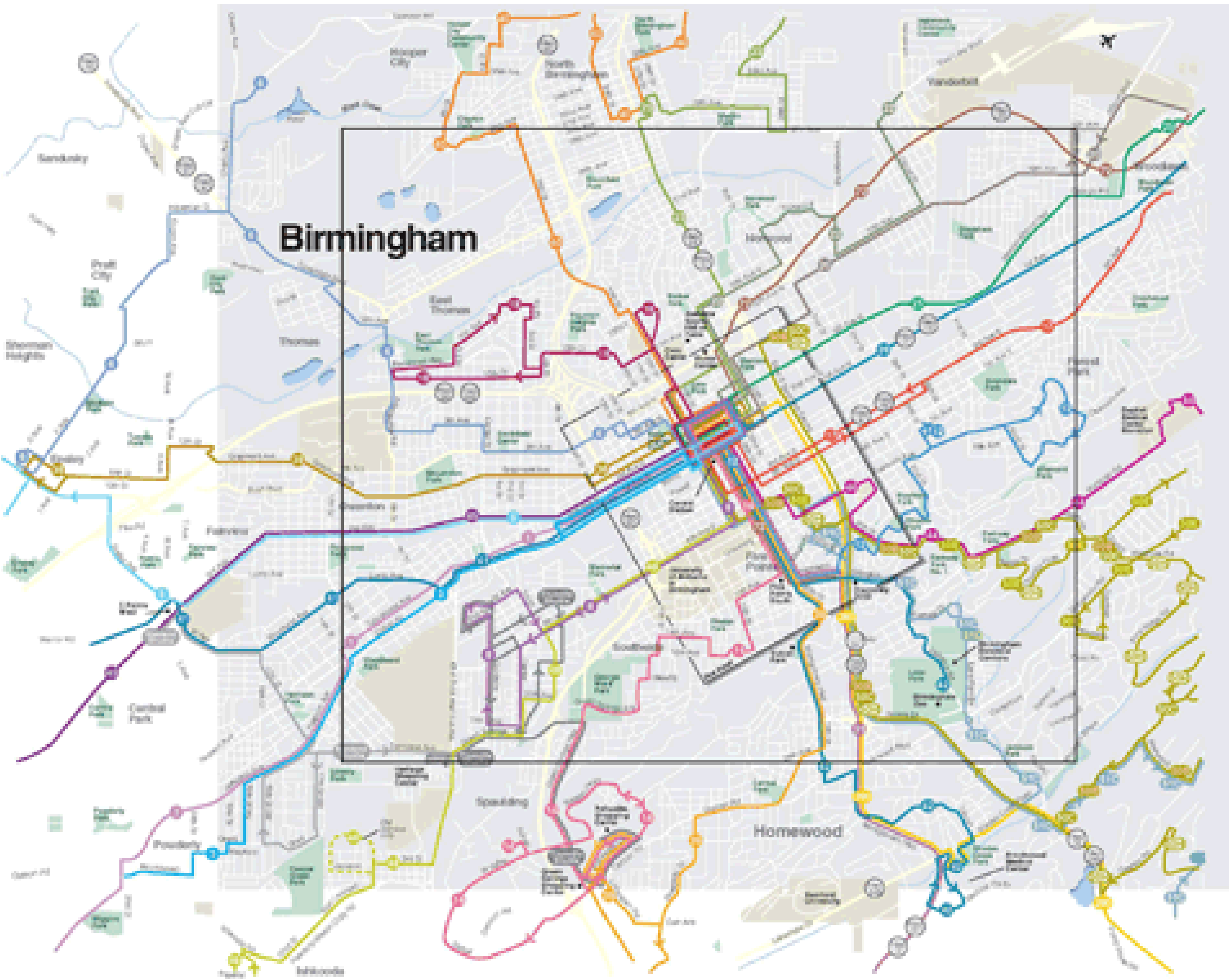
Public transit services throughout Jefferson County are provided by the Birmingham-Jefferson County Transit Authority (BJCTA). BJCTA has a service area population of 662,047. In 2000, BJCTA began replacing its diesel buses with cleaner compressed natural gas buses. BJCTA's bus route network is radial, with every route converging downtown. A few routes act as circulators once they are outside of downtown, meandering through neighborhoods (see Figure 13). BJCTA offers the following services:

- **Fixed-Route Bus** – BJCTA operates 35 bus routes, including one express route, two shuttles, three downtown circulators, and one limited stop route.
- **VIP** – BJCTA's ADA complementary paratransit service provides door-to-door demand response service for qualified persons with disabilities.

The adult cash fare for fixed-route services is $1.25 or $44 for a monthly pass. Transfers are $0.25 when purchased with the initial fare.

[8] Birmingham population from U.S. Census Bureau, 2009 Population Estimate.

Figure 13 Birmingham-Jefferson County Transit Authority System Map



Central Ohio Transit Authority in Columbus, Ohio

Columbus lies at the confluence of the Scioto and Olentangy rivers in central Ohio. Columbus is the state capital and Ohio's most populous city, with 769,332 residents.[9] The metropolitan area is home to 1,133,193 people. It is also home to Ohio State University, one of the largest universities in the United States with a student population on the order of 50,000 students. The city has a relatively high population density (second among the peers after Norfolk). Similar to Memphis, Columbus has a relatively high poverty rate, at 21%.

Public transit service in the Columbus area is provided by the Central Ohio Transit Authority (COTA). COTA has a service area population of 1,057,915. COTA is one of the first transit agencies to switch to a biodiesel fuel blend to power its fleet of buses. COTA is in the process of rolling out real-time information to its riders, and is currently testing the technology with selected rider groups. COTA has studied the possibility of developing BRT and light rail, but a lack of funding has prevented any of these studies from moving forward into implementation.

The COTA bus system is a combination of both a radial and grid system design (see Figure 14), with service centers in downtown Columbus and at Ohio State University. The radial and grid design acknowledges that while most routes travel in and out of downtown, there is also a loose service grid laid on top of the system, especially on the north end of town. COTA services include:

- **Fixed-Route Bus** – COTA operates a total of 76 routes, including 29 local routes, 38 express routes, 8 cross-town routes, and one neighborhood circulator.
- **Mainstream** – COTA's ADA complementary paratransit service provides door-to-door demand response service for qualified persons with disabilities. This service is contracted out to a private operator.

The adult cash fare for fixed-route services is $1.75 or $55 for a monthly pass. The fare for express routes is $2.50 or $76 for a monthly pass. The fare for the LINK circulator is $0.75. Transfers are free.

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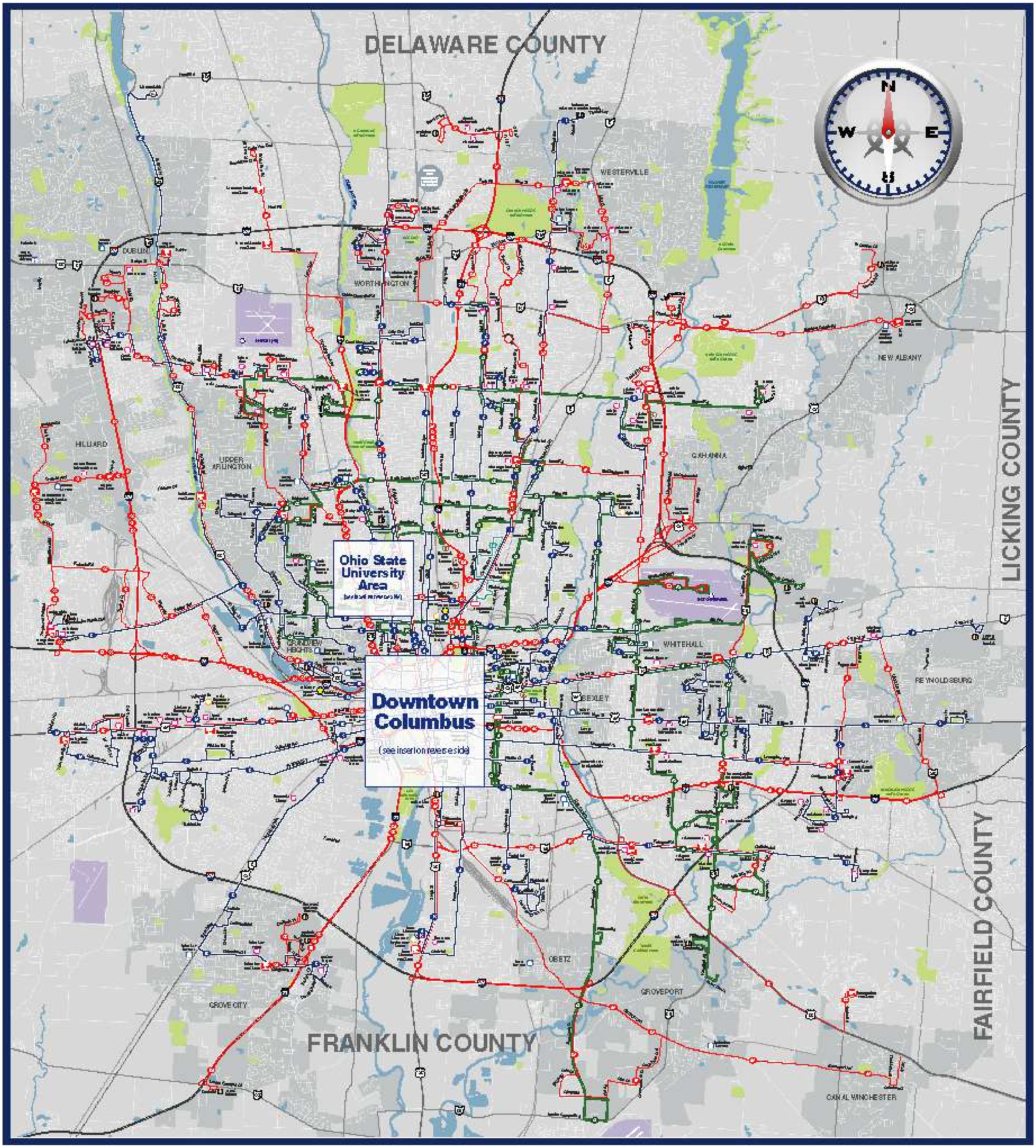
[9] Columbus population from U.S. Census Bureau, 2009 Population Estimate.

Figure 14 Central Ohio Transit Authority System Map



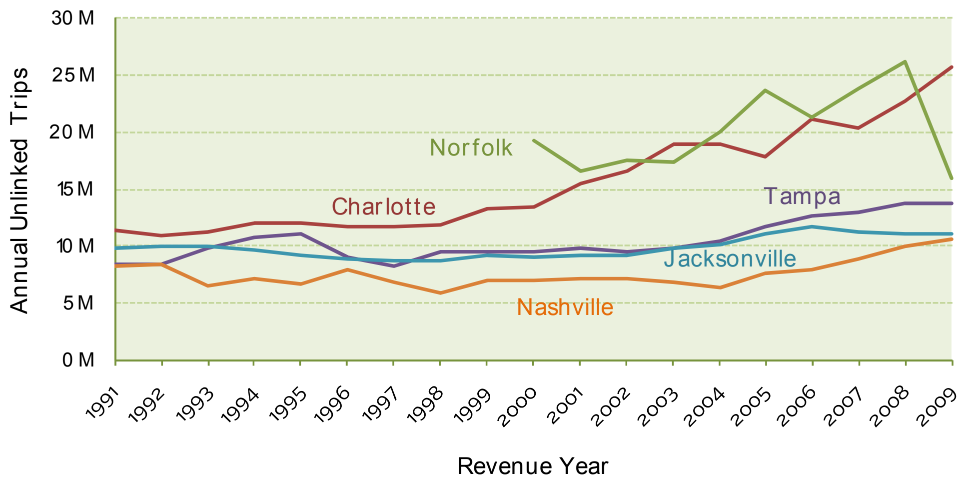
CHAPTER 3: QUALITATIVE MEASURES

The study team identified three key issues to be included in the peer review: (1) ridership history and strategies; (2) service design; and (3) transit technologies and intelligent transportation systems. These subjects cannot be easily compared using quantitative statistics; instead, they are evaluated qualitatively and presented in the following descriptive text.

RIDERSHIP HISTORY

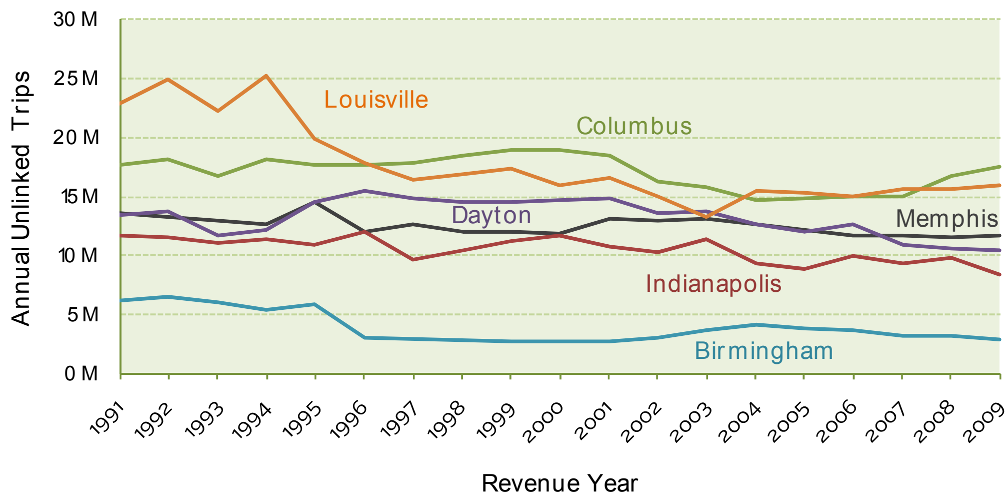
The ability to attract and retain riders is an essential function of all transit agencies. As part of our peer analysis, therefore, we considered how other transit agencies have successfully developed ridership over time. The baseline of our ridership analysis began with the NTD statistics; this data allowed us to understand ridership trends by agencies. Looking back to 1991, five of the peers have experienced overall ridership growth (see Figure 15), while five of the peers have experienced overall ridership declines (see Figure 16).

Figure 15 Peers Experiencing Ridership Growth



Source: National Transit Database 2009

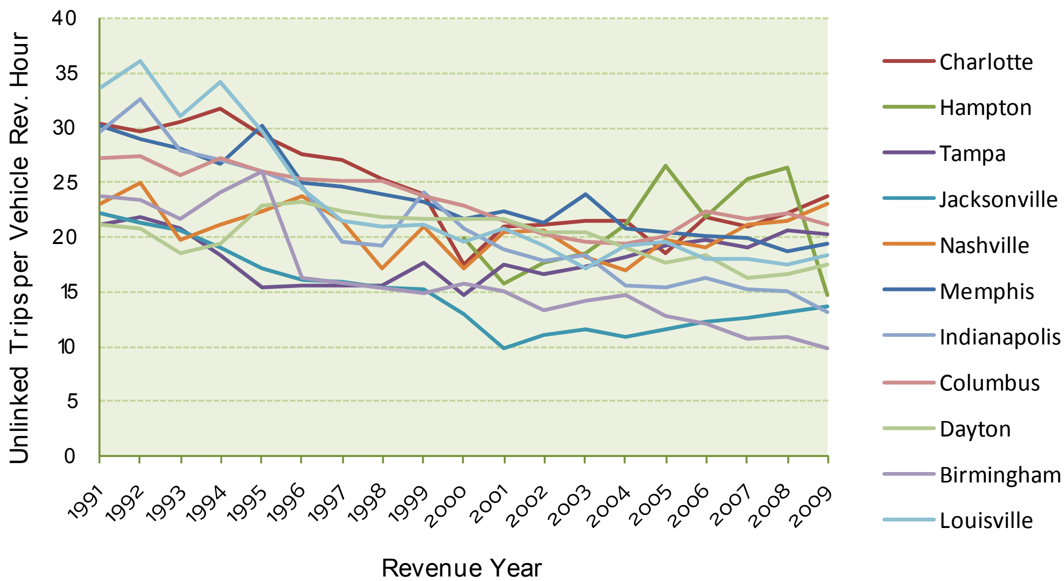
Figure 16 Peers Experiencing Ridership Declines



Source: 2009 National Transit Database (NTD).

To understand these ridership results, it is important to assess passengers per hour trends. We looked at the historical ridership performance of each agency *after accounting for service level changes*. To do this, we used a service productivity measure — the number of unlinked passenger trips per vehicle revenue hour. In other words, this measure is a ratio of ridership per unit of service. The results, shown in Figure 17, indicate that all but two of the peers had declining productivity over time. Nine of the eleven agencies (including Memphis) had a declining productivity, while Norfolk and Tampa experienced very slight increases in productivity (measured by a linear regression analysis of the data points — i.e. the "slope" of the lines). This indicates that generally the peers have not been able to increase ridership *without* increasing service.

Figure 17 Passengers per Revenue Hour by Year



As part of the peer review, the Nelson\Nygaard team conducted telephone interviews with each peer agency and a key part of these discussions included understanding how each agency has worked to increase and maintain ridership. Key ridership lessons and strategies include:

- **Increasing service levels usually leads to ridership increases**. Among the two agencies with the greatest increase in ridership – CATS (Charlotte) and HRT (Norfolk) – both agencies saw ridership increases while their service areas expanded, the amount of service provided grew and the service diversified. In the case of Charlotte for example, as shown in Figure 15, ridership was fairly flat between 1991 and 1999, despite the fact that the population of Charlotte was growing rapidly. Real gains in ridership came in 1999, when the Charlotte Transit merged with the Metropolitan Transit Commission to create the Charlotte Area Transit Authority (CATS). This merger resulted in an expanded urban-county service area, the addition of several new routes and the addition of express service. A second dramatic increase in ridership occurred in 2007 after the opening of the LYNX light rail system. Hampton Roads Transit (Norfolk) has a similar story. The system consolidated services in 1999 and used this newly formed regional structure to expand and diversify the service network. New services included local community circulators and regional express services, all of have proven to be strong engines for increased ridership. Both CATS and HRT are continuing to work on diversifying and expanding their services.

- **Service quality is critical in attracting and retaining riders**. Qualitatively, CATS reported that it felt their ridership improved once they were able to improve service reliability. They attribute ridership gains to using an Automated Vehicle Locator (AVL) system to focus on improving on-time service reliability to 88% (where "on time" means a bus arriving at a stop between zero minutes before and 5 minutes after the schedule time). CATS felt that improving service reliability is a key way to retain passengers, especially on routes with less service frequency.

- **Allocate resources to the most productive uses**. Very often, a large portion of a transit agency's total ridership is concentrated on a small number of very productive routes. This can lead to stagnant ridership, as unproductive routes use valuable resources that could otherwise be put to better use. Reallocating resources to service that produces better results can result in significant improvements in ridership and system productivity.

  HRT (Norfolk) found itself in this situation when they discovered that 67% of their total ridership came from only 21 of their routes — or that 26% of their routes produced 67% of their ridership. They began a project to analyze every trip of every route, in an effort to learn where service was productive and where it was not. From the effort, they identified routes and trips that didn't make sense to run because of low ridership. They then devised a plan to reallocate these unproductive resources — $4.5 million annually — to increase service on the productive routes. Their plan is in the implementation stage, and they are convinced that this focus on putting resources where they will most benefit riders will result in increasing ridership.

  Managers at several other agencies reiterated the link between effectively reallocating resources and increasing ridership. Trimming unused fringe trips, eliminating unproductive trip variants, and simplifying routes are some of the strategies that managers at HART (Tampa), HRT, and IndyGo (Indianapolis) have used to improve productivity and increase ridership. Several managers remarked that this is often easier said than done — reallocating service negatively impacts some riders and is often politically sensitive.

- **Expansion into new markets**. Several agencies commented on the need to constantly assess the travel market and identify new opportunities to provide service. Transit agencies that adopt a more market based approach are able to capture high volume markets that help improve overall system ridership. Some of the market-based strategies adopted by the peer agencies include:

- **Transit pass programs with educational institutions, especially large universities**. Several transit agencies have U-Pass programs, which are programs where universities and transit agencies negotiate a pass program that allows all students to receive an unlimited ride pass. The university pays for the pass, but pays on a negotiated rate that typically reflects pass usage. The cost of the passes is almost always paid by the school and passed on to the students in the form of a student fee. COTA (Columbus) provides a good example of a successful university pass program that began in 1997. Under this partnership, Ohio State University students pay a mandatory fee of $13.50 per semester and get unlimited rides on COTA services. The program has resulted in significant ridership increases for COTA.

- **Transit pass programs with major employers**. Similar to school pass partnerships, the transit agency partners with local employers to provide transit passes to employees. Generally, if the employer pays for the passes, they negotiate a discounted rate and purchase them for all employees (the employer may be eligible to deduct the expense of this benefit on their federal taxes). Alternatively, the employer can offer the pass as an optional pre-tax deduction from the employees' pay. Nashville's MTA has developed an employer pass program called *EasyRide* and considers the program a major success in their expansion into new markets. COTA (Columbus) offers a program where COTA delivers a number of passes to the employer every month, employees purchase the optional passes and COTA picks up the unsold passes at the end of the month.

- **Special event shuttles**. Transit agencies can play an important transportation role for special events such as sporting games or conventions. These type of events can be relatively straight-forward to serve because they usually involve a large number of people going to a single location. A sporting event can be served by identifying various pickup locations (often park and ride lots, downtown locations, or transit centers) where a fleet of buses carry people to and from the event before and after games. Jacksonville's JTA offers a *Stadium Shuttle Service* to sporting events (commonly Jaguars games) at EverBank field. A fleet of buses offers service between the stadium and several suburban and downtown locations before and after games. Service is only on game days and the trips are scheduled to coincide with the game. In 2008 JTA offered the service for 13 events serving more than 60,000 people.

There are regulatory issues associated with offering this type of service. Due to a 2007 Federal Transit Administration rule, public transit agencies risk losing all of their federal funds if they operate this sort of special event “charter” service unless the agency qualifies for an exception (which can include the lack of an expression of interest from a private transportation company). Public transit agencies in Miami, Seattle, and Nashville each had to discontinue special sporting event services as a result of this rule.

– **School Tripper service**. Many transit agencies have been able to expand their market by providing service that is oriented to students. This can be in the form of "school trippers" which are extra trips on regular fixed-routes timed to correspond to school bell schedules, circulator service throughout a campus, or transit service that is coordinated to complement university transit systems. COTA (Columbus) provides significant service to Ohio State University, focused on convenient transfers to and from the university's own circulator bus service. This coordination of services, along with the universal student pass program, has resulted in student ridership increases.

  Again, there are federal regulatory issues associated with offering school tripper service. Generally, school tripper service must meet a number of criteria — it must be open to the public, it must operate using regular bus stops, it cannot carry any special designation (“school special” or similar), it must be on regularly published schedules, and it must accept various fare media. Basically, school tripper service must “operate and look like all other regular service.”

– **New modes of service**. Transit networks can attract new riders by deploying service that appeals to new segments of the travel market. Several of the peer agencies were successful at capturing new markets by deploying specialized or targeted service (express and commuter buses and/or regional services). Nashville's MTA has invested in its highest ridership corridor by deploying a light version of BRT service —upgraded stations, real-time data, limited stops, transit signal priority, and specialized vehicles. The service has been a success and ridership on the corridor has increased.

- **Fare restructuring**. A transit system's fare structure is often overlooked as an opportunity to improve service, but empirical evidence suggests that diversifying their fare structures can help attract new riders or different rider groups. Tampa's HART system, for example, modified its fare structure by eliminating transfer fees, replaced their monthly pass with a 31-day fare card, and replaced the weekly pass with a 3-day pass. The fare restructure has resulted in an overall increase in ridership and an increase in the agency's average fare per passenger (from $0.88 to $0.99).

These strategies and their success at other agencies suggest that there may be opportunities for MATA to increase ridership by learning from industry best practices. Appealing strategies for increasing MATA ridership include:

- **Focus on service quality, especially on-time performance**. Peers have learned that having good on-time performance is important to attract new riders and build ridership. MATA should explore strategies to improve performance in this area, and MATA's Intelligent Transportation Systems project will be a key component of this effort (see discussion of ITS later in this chapter).
- **Allocate resources to their most efficient and productive use**. Unproductive routes and trips consume valuable resources that could be put to better use elsewhere. Some peers have had success in improving productivity by committing to a demand-driven service allocation process. The MATA Short Range Transit Plan's route evaluations will make recommendations towards this goal.
- **Partner with local institutions to offer universal pass programs**. Many agencies have been able to increase ridership by expanding into new markets. Local institutions with large clusters of people can often be very attractive sources of new ridership that may be relatively easy to serve. Large area employers such as FedEx, Memphis City Schools, and local hospitals may be potential partners in new universal pass programs. The University of Memphis could also be a potential partner with a student and faculty pass program.
- **Seek out new markets**. Some peers have had success in offering more specialized service for special events, schools, and sporting events. While there may be regulatory issues associated with offering these services, they are often quite productive due to the great number of people traveling to one location. MATA already offers some special event services, such as the shuttle service to Tigers and Grizzlies games at the FedEx forum, but there may be additional opportunities to offer specialized service, such as Memphis in May events.

SERVICE DESIGN

This section considers system design — how the bus network is structured to deliver service across a service area. There are countless ways to design a network of fixed-route bus service, but in general transit systems need to work within the spatial distribution of population, employment and other activity centers, as well as work with the existing road network. At the same time, the system design needs to be responsive to local markets and travel patterns. For example, historically, a large portion of trips were between downtown and outlying residential areas; this model is fairly easily served by transit because a system could focus on serving many residential areas and a single destination (downtown). This model has changed dramatically over the past several decades, as population and employment has moved toward a more polycentric distribution of activity centers. This increases the complexity for transit services because the same (or smaller) sized demand for travel want service to a multitude of destinations. Some systems have responded to these changes by creating hybrid structures, diversifying service options and/or focusing on key markets.

Three of the most common designs are described below. In general, most transit agencies follow some sort of hybrid of these designs.

Radial. As mentioned, a radial, or hub-and-spoke network design is a traditional and fairly common service model. Under this design, most routes serve the downtown central business district and then radiate out from it to serve the outlying communities. This design seeks to provide a fairly simple route structure that serves the largest destination (downtown). Commuters are attracted to direct and relatively fast service into downtown and in many cases the services can help avoid expenses associated with driving such as traffic congestion and/or high parking fees. Non-commuter riders may also find the system attractive if downtown is also home to important activity centers such as schools, shopping, entertainment venues, medical offices and community centers. The primary drawback of the radial system is that it does not work well for riders whose trip does not involve downtown because travelers must travel downtown just to make a connection to another route.

Grid. An alternative network design is one where transit routes form a grid that blankets the service area. Under a grid system, bus routes are laid out along parallel streets and are intersected by perpendicular routes. Because intersections of routes are common, the opportunities to transfer between routes are more numerous. This type of design works well for riders with dispersed travel patterns because it is relatively easy to get from one place in the network to another and most trips can be accommodated with a single transfer. The main drawback of this design is the emphasis on transfers, which necessitates fairly frequent and coordinated routes. Because most trips involve more than one route, transfers must be easy, seamless, and quick. This means that schedules will need to be coordinated, headways will need to be relatively short, and reliability will be critical.

Transit Hubs and Centers. Another network design that is based on dispersed travel patterns is the transit hubs and centers, or polycentric system. This design utilizes transit centers placed strategically at major activity centers throughout the service area, with interconnecting routes. The transit centers become the emphasis of the system instead of the central business district. This design can effectively serve a dispersed service area and is not dependent on an underlying grid network. This design allows for greater flexibility in scaling service levels to match land use and corridor densities. Headways can be lengthened in areas of lower density and shortened in areas of higher density. The success of the system requires timed transfers at the hubs, fast and direct service between hubs and investment in passenger amenities and facilities at the hubs.

The peer systems offer a glimpse into how other systems have designed their networks and tried to work with the underlying land forms. The networks are described here and system maps can be referenced in Chapter 2.

- MTA (Nashville) is a good example of a city with a radial bus network, having adopted a route network where nearly every bus route converges downtown. This radial network is anchored in their new (2008) downtown transit center (i.e. Music City Central). This climate-controlled indoor-outdoor station serves 20,000 riders on weekdays — indeed, many of them transferring passengers.
- CATS (Charlotte) provides a good example of a system that is designed around the geography and the travel market of the service area. While many of CATS' routes operate in a radial fashion and serve the strong downtown, the system also takes on a polycentric design, with many routes that connect important activity centers throughout the region. The system uses four transit centers, three of which are outside of downtown at activity clusters, with a series of interconnecting routes to match the multi-destination travel needs of riders. This design works relatively well for CATS, where the unique geography of the area — hilly, mountainous terrain with very irregular street patterns — prevents CATS from using a grid-like system.
- HART (Tampa) provides a good example of a system that has adopted a grid-like route network while also using transfer hubs extensively. HART has the benefit of a grid-like street network throughout much of its service area, which is effective in delivering a transit network with a grid pattern, particularly in the northern half of its service area.

HART's grid is anchored around a handful of fast, frequent and direct routes that operate along principal arterials and bring people into downtown. Passengers can connect to these routes to travel into downtown and use them reach cross-town routes. In addition to a grid-like pattern, HART's system design utilizes 12 transfer centers (two downtown) throughout the service area that offer ample transfer opportunities.

- HRT (Norfolk) uses a philosophy of numerous hubs and centers to deliver service across its irregular and polycentric service area in which the water acts as a barrier to linear transit network design. As shown in the service map (Figure 9) there are 45 transfer or transit centers placed strategically throughout the service area, most of which are outside of downtown areas. These transfer and transit centers allow HRT to provide connections between multiple municipalities and create multiple travel paths between destinations.

There is no single design that works best for all transit, nor is there a single design that works best for a particular city. Service design is an exercise in balancing tradeoffs and matching service to the travel market and the unique geography of the region. **MATA has a route network that is fairly radial in design where most routes serve downtown Memphis but is also built around a few transit hubs. In addition, five crosstown routes offer service between areas of Memphis outside of downtown. A weakness in the radial system is a lack of route directness and a weakness in the transit hubs system is the lack of strong connections between transit hubs.** These inefficiencies negate one of the premises of radial service design — quick travel to and from downtown. Likewise, the lack of strong connections between transit hubs makes it difficult to use the hubs to focus and disperse service. This causes the entire system to suffer, as transfers become a burden for riders. The system does a good job of providing coverage throughout the service area, but with improvements the system could provide more attractive service and serve more riders.

TECHNOLOGY AND INTELLIGENT TRANSPORTATION SYSTEMS

Similar to the consumer market, there is an increasingly diverse set of transit technologies available to support transit services. Transit agencies have adopted different philosophies with regards to how they approach technology. On one end of the spectrum, some agencies feel investments are best spent on services. Other agencies have invested significant capital dollars in technologies to help them manage services and provide conveniences for their riders. These technologies include systems such as automated passenger counters, computer-aided dispatching, and real-time information based on onboard GPS units. These technologies are commonly referred to as Intelligent Transportation Systems (ITS). The following offers a brief description of some common ITS technologies, followed by a matrix of the peers' usage of these systems and technologies (see Figure 18).

Automated Vehicle Locators/Computer Aided Dispatching (AVL/CAD). Automated Vehicle Locators allow the central computer system to know the location of the vehicle fleet in real-time. Computer Aided Dispatching usually works in conjunction with AVL technology to aid in dispatching. These systems can benefit an agency by providing schedule adherence data, allow for automated next stop announcements, and can help increase the fleet size that a single dispatcher can handle.

Most of the peers have invested in AVL/CAD technologies for their fleet. CATS (Charlotte) has AVL/CAD technology on 100% of their bus fleet. Managers at CATS remarked that the availability of 100% sample data for their bus fleet has allowed them to improved service remarkably, particularly on-time reliability and schedule adherence.

Automated Passenger Counters (APCs). APCs automatically count riders as they board or exit a vehicle and tie this data with locational data from the AVL system, providing stop-level ridership data. This ridership data can then be used for a multitude of purposes, such as improving scheduling, improving routing, analysis of ridership patterns, and more. Many agencies have installed APCs on a limited number of their vehicles in order to control costs. They rotate these vehicles through the routes in order to collect a sample of each route's ridership data over time.

All of the peers have APCs installed on at least some of their fleet and most are actively using the technologies, except for Nashville, which is currently testing the technology. Managers at many of the agencies remarked that they have found APC data incredibly useful and have a policy of making sure APCs are installed on all new vehicles. CATS (Charlotte) and IndyGo (Indianapolis) both have APCs on 100% of their fleet. HRT (Norfolk) has APCs on approximately 15% of its fleet (all new vehicles will have APCs installed). MTA (Nashville) is in the process of installing APCs in its fleet.

Real-Time Information (RTI). This technology builds on AVL/CAD infrastructure by bringing the technology directly to the end-user in the form of real-time, automated next bus information. This technology provides real-time tracking information for buses and can tell the rider when the next bus will actually arrive at a stop. Once the back-end system is in place that tracks the vehicles as they move, the information can be delivered via numerous methods. These can include signage at bus stations, text messages directly to riders, smartphone apps, and internet portals. This information can be very important, particularly for routes with less service frequency or unreliable service.

Real-Time Information is a relatively new technology and is just beginning to make its way to many transit agencies. COTA (Columbus) is currently testing RTI with a select group of riders (students at Ohio State University) in anticipation of rolling the technology out system wide. MTA (Nashville) has the back-end system in place and is looking forward to rolling out the information to its BRT stations and the downtown transit center. HART (Tampa) and CATS (Charlotte) have limited RTI systems in use.

Ticket Vending Machines (TVMs). Ticket Vending Machines are automated machines that collect fare payment and dispense fares at stationary sites. TVMs most commonly serve non-bus transit modes such as light rail or bus rapid transit.

HRT (Norfolk) has a limited number of TVMs in major transit centers, but are deploying more on the light rail platforms as the construction of the light rail system concludes. MTA (Nashville) and HART (Tampa) use ticket vending machines at their downtown transit center.

Transit Signal Priority. This technology reduces the time buses spend waiting at red lights by using an automated system where the traffic signal modifies cycle times as a bus is approaching in order to give the bus a green light. The infrastructure required is expensive, requiring upgrades to both the signal controller and also onboard the bus.

This technology is usually deployed by larger transit agencies on high-level transit services such as light rail or BRT. MTA (Nashville) has limited transit signal priority on its BRT route and plans on adding more routes in the future. JTA (Jacksonville) is developing an implementation plan for several corridors and have performed limited testing.

Electronic Fare Collection. Handling cash can be onerous for both the users and the providers of transit service. Cash fare payment increases dwell time and requires time-consuming processing when the fareboxes are emptied. Moving to electronic fare collection, where users load money onto prepaid electronic cards, can improve service by reducing dwell times while saving the agency money. Electronic fare collection is typically deployed by larger transit agencies. None of the peers have electronic fare collection systems.

Wi-Fi. Deploying Wi-Fi on transit vehicles is slowly becoming more common in the industry, though typically at larger transit agencies. Wi-Fi is typically deployed on modes with a longer average trip length, such as commuter rail or express buses. Some transit agencies have found the technology to be problematic and expensive, while others have had limited success. None of the agencies in the peer group have deployed Wi-Fi on their vehicles.

Figure 18 shows the varying levels of technology implementation amongst the peers. Some technologies such as AVL, CAD, and APCs, are nearly ubiquitous amongst the peers. These technologies have become more commonplace throughout the industry and are now considered standard investments in delivering modern bus service.

MATA currently has a relatively low level of investment in transit technologies, though a comprehensive program to invest in ITS is underway. This new program will bring MATA's technology usage up to par amongst its peers. MATA's new technology investments under this program include APCs, AVL/CAD, automated vehicle health monitoring, automated voice annunciation, customer information signs, a new radio system, mobile data terminals for operators, and on-board security cameras. These new technologies will help MATA offer better, safer, more reliable, and more efficient service. The new APCs will provide MATA with a wealth of ridership information on an automated and ongoing basis. The proposed Real-Time Information technology investment is another ITS component that will provide an opportunity for Memphis to get ahead of the curve while providing a substantial rider benefit. This technology will be particularly helpful for riders on low-frequency routes and at transit centers. The lack of ticket vending machines is not significant for MATA, as these are normally deployed for higher-capacity modes absent in the Memphis transit mix, such as BRT, commuter rail, or light rail. Electronic fare collection and WiFi technologies are normally deployed by transit agencies larger than MATA (MATA has already implemented a successful 1-day, 7-day, and 31-day pass program using magnetic strip media). Transit Signal Priority, uncommon amongst the peers, is fairly expensive and complex. MATA has executed a contract to implement GOS-based signal priority for the downtown trolley system. TSP could be a significant part of a service improvement plan that would prescribe a series of investments on a regional basis to improve bus service in key corridors. With the completion of MATA's ITS investment program, MATA will meet or exceed its peers in terms of transit technology usage.

Figure 18 Technology Usage of Peer Agencies

	Memphis, TN	Jacksonville, FL	Tampa, FL	Louisville, KY	Indianapolis, IN	Norfolk, VA	Charlotte, NC	Dayton, OH	Nashville, TN	Birmingham, AL	Columbus, OH
Automated Vehicle Locators	yes, testing	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Computer-Aided Dispatch	yes, testing	yes	no	yes	yes	yes	yes	yes	yes	yes	yes
Automated Passenger Counters	yes, testing	yes	yes	yes	yes	yes	yes	yes	yes, testing	yes	yes
Real-Time Information	yes, testing	no	yes	no	no	no	yes	no	yes	no	yes, testing
Ticket Vending Machines	no	yes	yes	no	no	yes	yes	yes	yes	no	no
Electronic Fare Collection	no	no	no	no	no	no	no	no	no	no	no
WiFi	no	no	no	no	no	no	no	no	no	no	no
Transit Signal Priority	in progress	studying	no	no	no	no	no	no	yes	no	no

Source: 2009 National Transit Database (NTD).

CHAPTER 4: QUANTITATIVE MEASURES

This chapter compares and contrasts MATA against the peers with a series of system level (i.e., all modes) criteria associated with funding sources, service area and operating characteristics, service productivity and operating efficiency, and cost efficiency and cost effectiveness. A tabular overview of the system wide operating statistics data is provided in Figure 19, while some of the measures also lend themselves to graphical representation in charts throughout the chapter.

Figure 19 System Wide Operating Statistics of Peer Agencies

	Memphis, TN	Jacksonville, FL	Tampa, FL	Louisville, KY	Indianapolis, IN	Norfolk, VA	Charlotte, NC	Dayton, OH	Nashville, TN	Birmingham, AL	Columbus, OH	Peer Average
Transit Provider	Memphis Area Transit Authority	Jacksonville Transportation Authority	Hillsborough Area Regional Transit Authority	Transit Authority of River City	Indianapolis Public Transportation Corporation	Hampton Roads Transit	Charlotte Area Transit System	Greater Dayton Regional Transit Authority	Metropolitan Transit Authority	Birmingham-Jefferson County Transit Authority	Central Ohio Transit Authority	
Transit Density: vehicle revenue hours per square mile	2,088	3,341	2,793	3,050	1,720	2,926	2,430	2,162	945	1,618	2,535	2,328
Transit Usage: unlinked passenger trips per capita	13.2	13.4	16.8	21.1	10.7	13.2	33.8	18.6	18.4	4.4	16.5	16.4
Operating Speed: mph	14.2	15.2	13.5	13.6	15.1	14.4	16.1	14.7	14.6	12.7	13.7	14.3
Service Productivity I: unlinked passenger trips per vehicle revenue hour	19.5	13.7	20.4	18.4	13.2	14.8	23.7	17.5	23.1	9.8	21.2	17.7
Service Productivity II: passenger miles per vehicle revenue hour	99.4	72.2	101.0	74.1	58.2	94.1	126.0	72.0	118.3	51.9	82.5	86.3
Service Efficiency: total vehicle hours per revenue vehicle hours	1.07	1.09	1.08	1.08	1.11	1.02	1.09	1.07	1.11	1.06	1.10	1.08
Cost Efficiency: operating cost per vehicle revenue hour	$88	$100	$96	$77	$88	$70	$107	$94	$97	$80	$99	$91
Cost Effectiveness I: operating cost per passenger trip	$4.50	$7.33	$4.72	$4.19	$6.70	$4.73	$4.51	$5.38	$4.20	$8.15	$4.67	$5.37
Cost Effectiveness II: operating cost per passenger mile	$0.88	$1.39	$0.95	$1.04	$1.52	$0.74	$0.85	$1.31	$0.82	$1.53	$1.20	$1.11
Subsidy per Trip	$3.67	$5.63	$3.81	$3.50	$5.49	$3.63	$3.67	$4.52	$3.20	$7.33	$3.87	$4.40

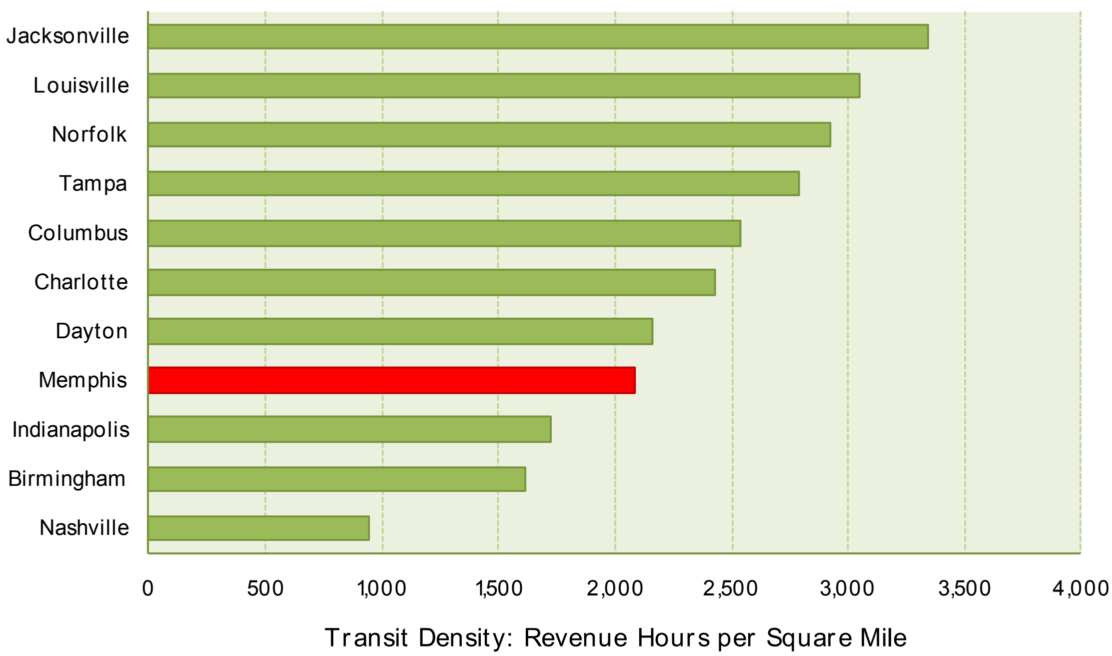
Source: 2009 National Transit Database (NTD).

SYSTEM WIDE OPERATING STATISTICS

The following measures are derived from the system wide operating statistics table, Figure 19. The data in the table is from the National Transit Database for report year 2009.

Transit Density. Transit density measures the amount of transit that is offered per unit of service area. MATA provides 2,088 revenue hours per square mile (see Figure 20), similar to the peer group average of 2,328. TARC (Louisville) and HRT (Norfolk) have high transit densities at 3,050 and 2,926 revenue hour per square mile, while MTA (Nashville) is quite low at 945 revenue hours per square mile.

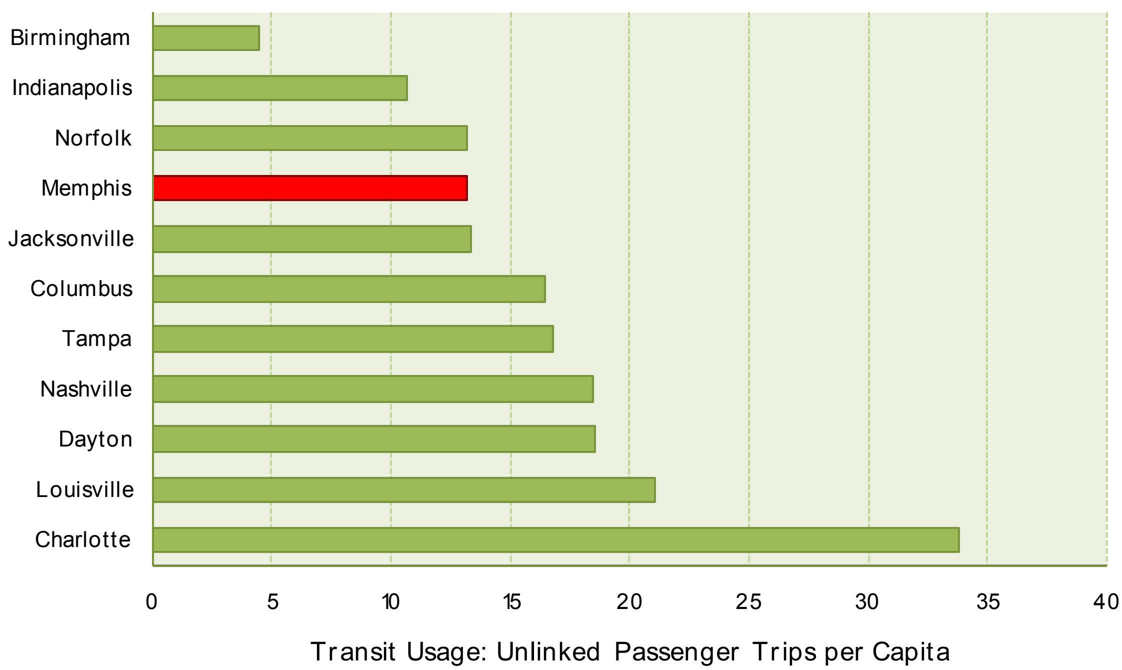
Figure 20 Transit Density by Peer



Source: 2009 National Transit Database (NTD).

Transit Usage. Transit usage measures the usage level of transit in the service area (it doesn't measure whether people *should* be using transit, but rather whether they *are*). It is measured by the annual number of transit trips per capita. MATA scores lower in this measurement (see Figure 21) — the peer group average is 16.4 annual trips per capita and MATA is 13.2. This indicates that, on a per capita basis, **the MATA population uses transit less than the peers**.

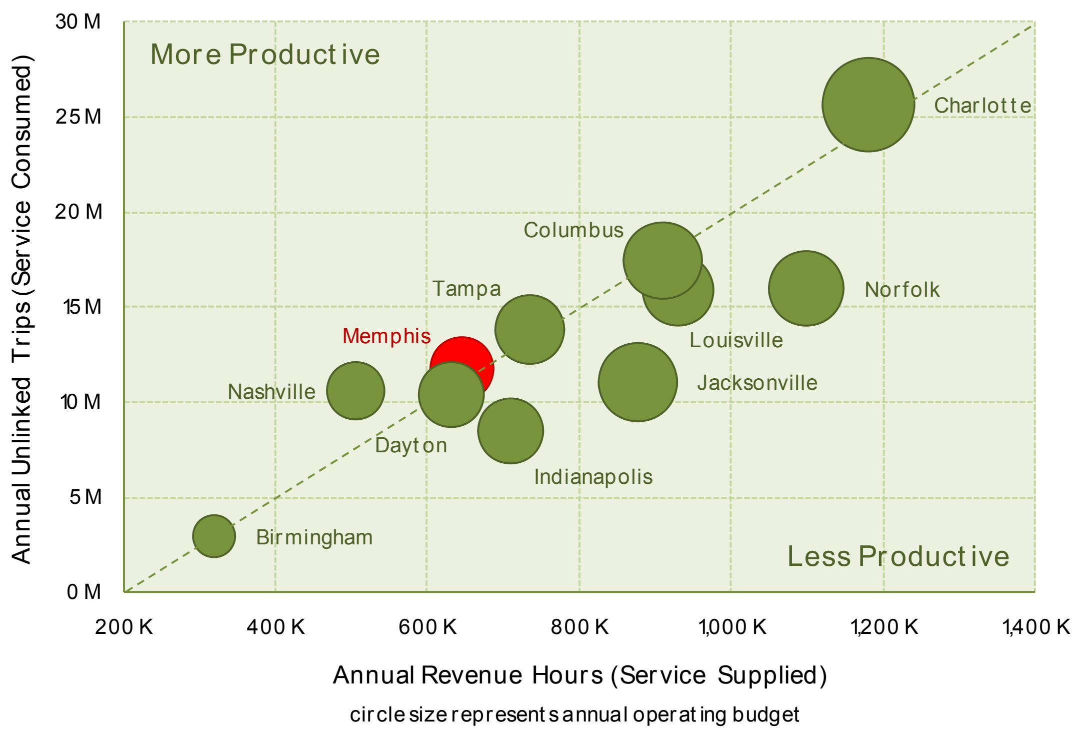
Figure 21 Transit Usage by Peer



Source: 2009 National Transit Database (NTD).

Service Productivity. Productivity reflects consumption for each unit of service produced. To measure transit service productivity, we consider the number of trips produced for each hour of service operated. This provides an indication of how productive, or well-used, a transit system is regardless of size or service mix. It does not, however, include the cost of service into the equation; the measure is purely based on usage per unit of production. Figure 22 shows a graphical representation of the analysis results. The horizontal axis is the amount of service that is supplied by each peer, while the vertical axis represents the amount of service consumed. The data shows that **MATA generally outperforms its peers in terms of service productivity.** MTA (Nashville) and CATS (Charlotte) have the most productive services in the peer groups, while IndyGo (Indianapolis), JTA (Jacksonville), and HRT (Norfolk) are considerably less productive.

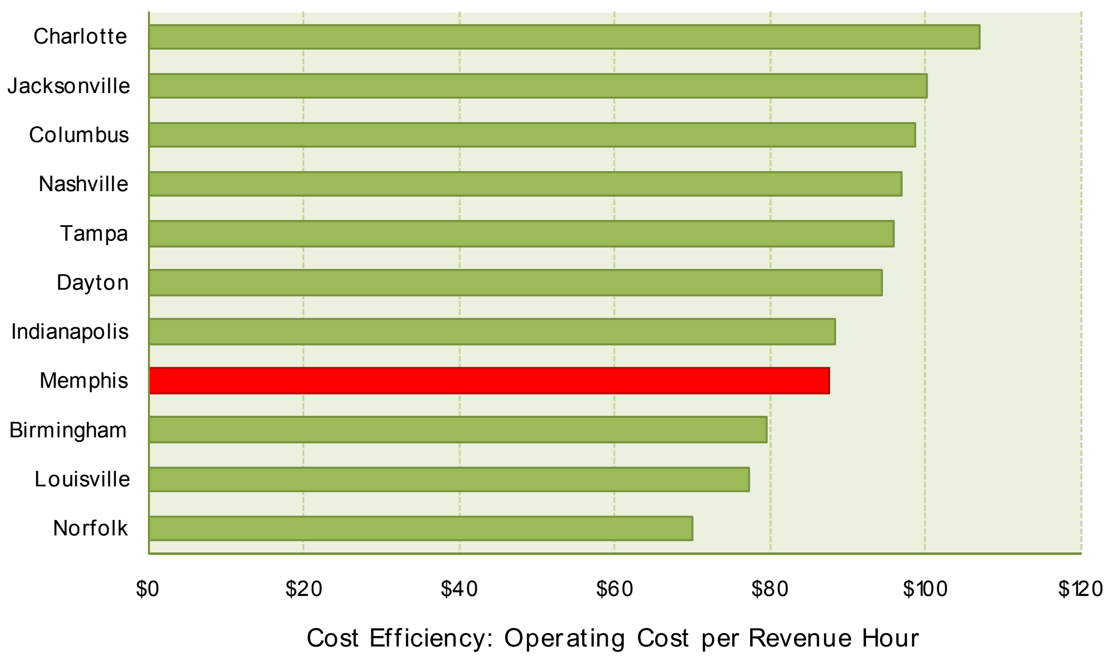
Figure 22 System Wide Productivity by Peer



Source: 2009 National Transit Database (NTD).

Cost Efficiency. For the peer review, cost efficiency reflects the cost to provide a unit of transit service, or a revenue hour of service. MATA has one of the lowest costs in the peer group (see Figure 23), with an operating cost per revenue hour of $88 (compared to the peer group average of $91). The systems with the highest costs were CATS (Charlotte) and JTA (Jacksonville), both of which operate expensive modes — CATS has a light rail line and JTA operates an aerial tramway.

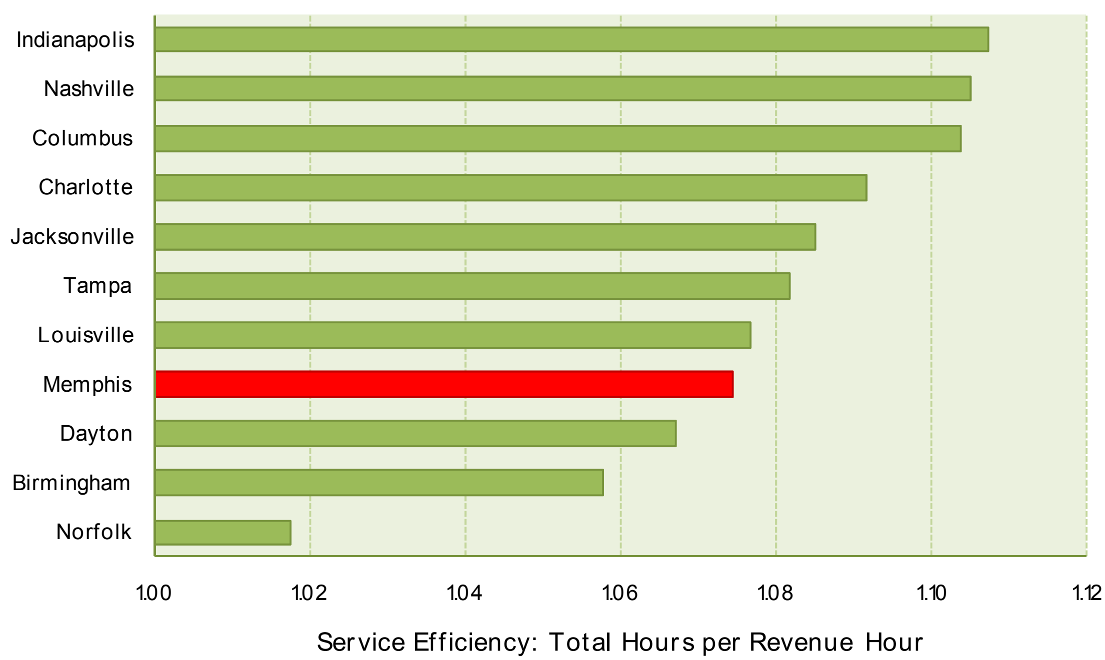
Figure 23 Cost Efficiency by Peer



Source: 2009 National Transit Database (NTD).

Service Efficiency. Service efficiency examines how efficiently service is being provided. In the case of transit service, this is measured as the ratio of total vehicle hours to number of revenue vehicle hours, or the proportion of time a vehicle is being used to earn revenue. A vehicle not being used for revenue purposes might be spent traveling to/from the start of a route (i.e. deadhead) or waiting at the end of the route so the driver can take a break and/or to ensure the next trip will start on time (i.e. layover time). According to this measurement, a perfect score would be 1.0. Recognizing that some non-revenue time is to be expected, the closer the number is to 1.0, the more efficient a system is. The peer group average for service efficiency is 1.09 (9% unproductive time). **MATA is more efficient than most of the peers, with a score of 1.07** (see Figure 24)**.** Service efficiency may be partially explained by the proximity of the North End Terminal to the garage at Levee Road, the relief practices used by MATA, and interlining among routes.

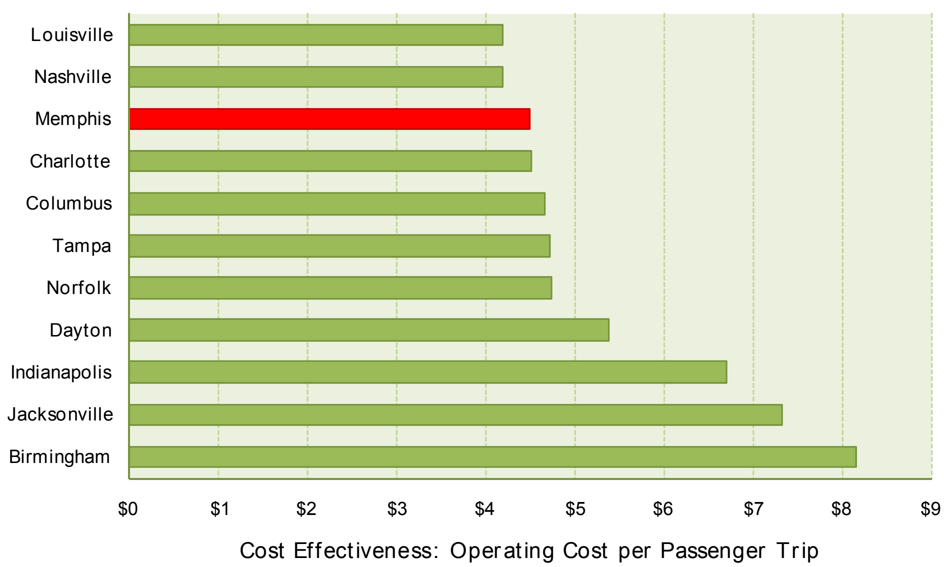
Figure 24 Service Efficiency by Peer



Source: 2009 National Transit Database (NTD).

Cost Effectiveness. Cost effectiveness takes the cost efficiency measures one step closer to the goal of carrying riders and relates the cost of service per unit of service consumption. We used two measures for cost effectiveness, comparing the operating cost per passenger trip (see Figure 25) and also per passenger mile. **MATA performs very well in both metrics, with a lower cost per trip and per mile than most of the other systems**. Likewise, the subsidy per trip (i.e. cost per trip less fares) for MATA is also better than the peer group average. MTA (Nashville) also stands out as also performing well in these effectiveness measures, as does HRT (Norfolk).

Figure 25 Cost Effectiveness by Peer



Source: 2009 National Transit Database (NTD).

CHAPTER 5: FINDINGS AND CONCLUSIONS

The intent of the peer review is to compare MATA with a handful of peers to assess how it compares and learn what it can do to improve service. Overall, the peer review found, from a quantitative perspective, MATA is consistent with the peer group. It is as productive and efficient as the peer group systems and outperforms its peers in terms of service productivity, cost efficiency and cost effectiveness. However, the peer review does highlight some opportunities for improvement. Some of the key findings for MATA include:

- **MATA is a productive and cost effective system**. MATA generally outperforms its peers in service productivity measures and cost effectiveness measures, from both a system wide and from the bus only perspective. This indicates MATA has done a relatively good job at operating an efficient and effective system. Peers that outperform MATA in these measures, such as MTA (Nashville) may offer lessons for how to strengthen the service design.
- **MATA's services have shrunk over time – both in terms of ridership and service hours deployed.** MATA, as a system, has slowly been shrinking over the last decade, both in terms of ridership and service hours deployed. The data suggests service cuts have been effective as reflected by MATA's consistent high levels of productivity (see previous chapter). However, the peer analysis shows that transit systems that have increased ridership over this time period have generally done so by expanding service, service areas and diversifying their service network. Other agencies suggest that focusing on service quality can also help attract riders. In both cases, agencies have adopted a more dynamic approach to transit service planning and these strategies have helped them retain and expand their ridership. Also demonstrated by the peer group is the importance of not sacrificing service efficiency and productivity while expanding service.
- **MATA service structure does not follow a clear service design.** Although much of MATA services are oriented towards a radial system, the system design is not

sufficiently or consistently followed (i.e. with direct and fast service into downtown) to realize the benefit of this design. Likewise, MATA's system operates around a handful of transit centers but with the exception of the downtown hub, the service is not strategically designed around these centers. As a result, MATA's route network is relatively more complex than its peers, with many indirect routes and only a limited grid or cross-town network that supports transfers outside of downtown.

- **MATA services do not have a clear hierarchy of routes.** Unlike almost all of the peer agencies, MATA does not have an internal route hierarchy that is designed to serve different markets and rider groups. By comparison, most peers provide more express services and several similarly sized and positioned agencies have higher end services, such as light rail or BRT.
- **MATA's population, on a per capita basis, is less likely to use transit as compared to the peer group**. Memphians are less likely to use transit when compared to their peers, which means the demand for transit is relatively low. This finding is unexpected, especially considering the relatively high poverty rate in Memphis. Columbus and Dayton, Ohio, for example, have similar poverty rates but higher per capita usage of transit. It suggests that MATA can do more to capture a larger share of the transit dependent market and do more to capture new markets.
- **MATA will benefit from its commitment to investing in transit technologies**. Many of the peers have had success and see value in investing in technologies that can make transit more attractive and effective. MATA's current program of investing in new transit technologies such as APCs, customer information signs, and mobile data terminals will yield big payoffs by allowing MATA to offer safer, more reliable, more relevant, and more efficient service.
- **MATA may benefit from market based strategies.** MATA has not adopted a market based approach to attracting riders, as shown by the lack of a strong service hierarchy and the relatively low per capita usage of its service. Following some of the strategies used by the peer agencies such as U-Pass programs, employer partnerships, and fare restructuring offer potential for MATA to diversify its ridership and improve ridership overall.