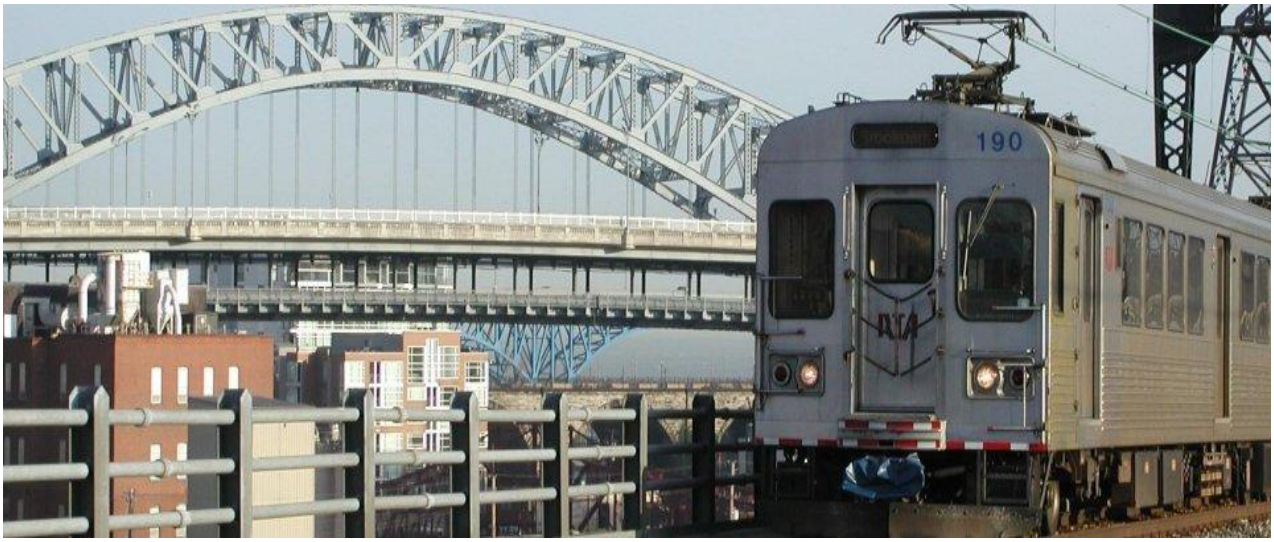
United States Department of Transportation - Federal Transit Administration
Advancing Transportation and Congestion Management Technologies Deployment Initiative
Funding Opportunity Number 693JJ317NF0001
June 12, 2017

Connecting Cleveland Project



Project Name	Connecting Cleveland
Eligible Entity	Greater Cleveland Regional Transit Authority
Total Project Cost	$18,000,000.00
ACTMTD Request	$ 5,850,000.00
Are matching funds restricted to a specific project component? If so, which one?	No
State in which project is located	Ohio
Is the project currently programmed in the: • Transportation Improvement Program (TIP) • Statewide Transportation Improvement Program (STIP) • MPO Long Range Transportation Plan • State Long Range Transportation Plan	The Connecting Cleveland project is programmed in the 2018 – 2021 STIP. It is PID # 104548 – GCRTA Radio, CAD/AVL System Replacement. Communications system upgrade is currently included in GCRTA's 2017 - 2021 Capital Improvement Plan (CIP) in the amount of $17.3 million.
Technologies Proposed to be Deployed:	GCRTA will upgrade its existing on-board vehicle equipment and radio system with 21st Century technology.

TABLE OF CONTENTS

Project Overview

Part I. Project Description

ATTACHMENTS

Project Overview

The following proposal demonstrates how the Greater Cleveland Regional Transit Authority (GCRTA) will utilize the Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) Initiative funds to support critical upgrades and maintenance of communications systems for both bus and rail service. The Connecting Cleveland Project (CCP) will improve communications infrastructure, transitioning GCRTA to 21st century technology. Improved communications will enhance rider and passenger safety, reduce rider travel time, and increase overall system efficiency, while acting as a driver for economic stability and growth for the Greater Cleveland region. The CCP will promote workforce development, contribute to community revitalization, and create pathways to jobs.

I. Project Description

PROPOSED TECHNOLOGY DEPLOYMENT

GCRTA will utilize CCP funding to upgrade software and replace the existing onboard vehicle equipment and radio systems. The CCP supports four main objectives:

- Increase rider and operator safety – replacing existing onboard technology will improve communication with GCRTA's integrated communications center (ICC) and public safety forces (police/fire/EMS) in real time. A turn-by turn navigation system will better assess operator driving performance, more accurately monitor emissions, and provide navigation services to operators, while interfacing with existing GCRTA computer systems.

- Provide real-time information – new software will provide passenger updates including live tracking and estimated departures from specific stop locations for bus and rail. Upgrades will allow for passenger updates every 15 seconds (as compared to the current three minutes). Data will be in an "open" format where application developers can utilize information. Information will be available through e-mail and internet. Custom text messages regarding service delays or re-routes will be provided. Real-time weather, news, and community information will be delivered through LCD screens at train stations, transit centers, and on vehicles. ADA announcements will be made in real-time.

- Enhance the rider experience – onboard audio announcements will be updated in a timely manner and announcements will be made in multiple languages. Riders will enjoy complimentary wireless connection access for mobile devices on all buses and trains. Travel times will be more accurately monitored and will allow for GCRTA to identify areas to improve on-time performance. Software will automatically provide updates when a bus is ahead of or behind schedule. Buses will be equipped with monitoring software that will identify maintenance issues, reducing repair costs and decreasing vehicle failures on the road. Paper records will be replaced with online

technology. Supervisors will be equipped with software that will allow them to automatically record and communicate information, including the ability to digitally record operator performance. Automatic passenger counters (APC) will be used to record passenger loads on specific routes, times of day, etc. to effectively plan scheduling to meet riders' needs.

- Implement connected communication – GCRTA will replace the current radio system with cellular technology. The computer aided dispatch and automated vehicle locator (CAD/AVL) system will utilize voice over internet protocol (VOIP) and better communicate within the organization itself, as well as with each community that GCRTA services.

Public transportation helps the entire community – commuters, the disabled, students, senior citizens, and even those who are not passengers. A strong public transportation system helps maintain and create jobs by connecting workers to employment, saves individuals money on transportation costs, and is critical to Greater Cleveland's economic and social quality of life. Funding the CCP will ensure GCRTA's ability to continue to provide reliable, affordable, uninterrupted service for decades to come.

ENTITY DESCRIPTION

Formed in 1975, GCRTA is the State of Ohio's largest public transit agency. GCRTA defines its mission as providing outstanding safe, reliable, clean, and courteous public transportation service throughout the Greater Cleveland area. GCRTA's vision is to be the choice for those with transportation options, and the lifeline for those dependent on its services, while acting as a champion for sustainable transportation. By reducing waste and emissions, while conserving resources, GCRTA's goal is to achieve a triple bottom line – people, profit, and planet.

In April 2013, GCRTA's HealthLine BRT received the highest ranking for a bus repaid transit (BRT) in the United States, from the Institute of Transportation and Development Policy (ITDP). The HealthLine has garnered national attention for GCRTA, as the $200 million project was the first BRT in the country to receive a full funding grant agreement (FFGA) in FTA's New Starts Program. The HealthLine has acted as a catalyst for redevelopment of Cleveland's Euclid Corridor, spurring over $6.3 billion in investment since its inception, including the addition of sixteen (16) new retailers in downtown.[1] A recent Cleveland State University study found that the number of jobs along the HealthLine has doubled since its launch in 2008.[2] The HealthLine is being utilized as a national model, with components being replicated in transit systems in Oregon, Washington, California, Florida, and Washington D.C.

[1] Downtown Cleveland Market Update Q4 2015, Retrieved 6-1-17, From: http://www.downtowncleveland.com/DCA/media/DCA_Media/Work/Reports/q4_final.pdf
[2] 2016 Downtown Cleveland Alliance Report, Retrieved 6-1-17, From: http://www.downtowncleveland.com/getmedia/22505da6-269e-4826-862f-25d35e253164/DCA_AnnualReport2016_Spreads

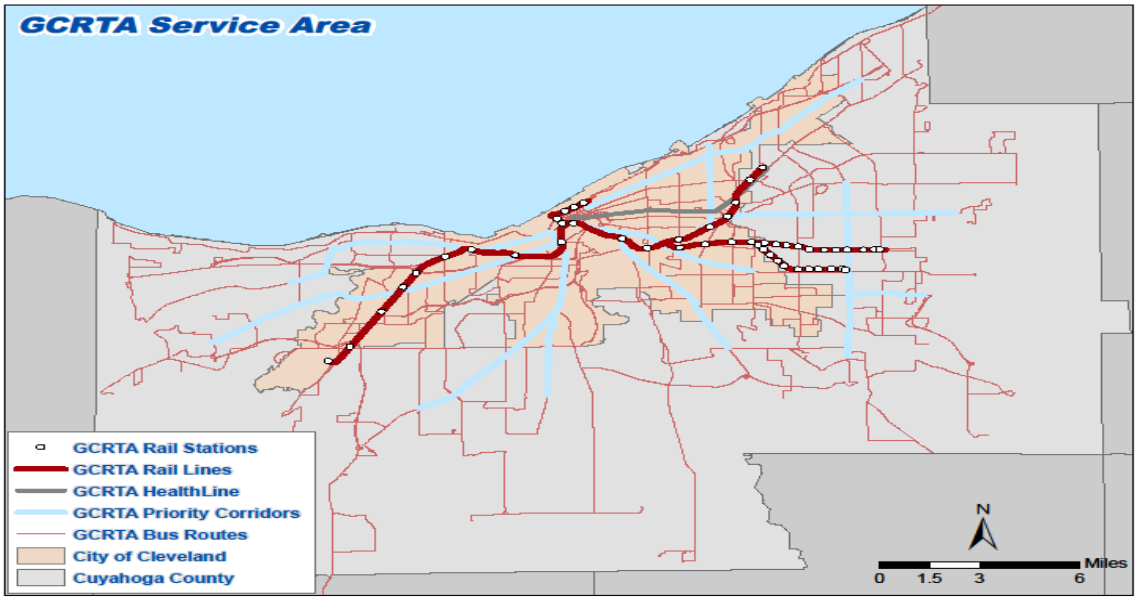
GCRTA's Manager of Intelligent Transportation Systems (ITS) will be the primary contact for oversight of the CCP project, along with the Deputy General Manager of Engineering & Project Management and the CIO/Executive Director of IT. Legal Affairs, Operations, Accounting, Finance, Procurement, Grants Management and the Audit departments will conduct oversight for the CCP project as well. The aforementioned grant awards have provided the team with the experience necessary to effectively execute the CCP project, while ensuring adherence to all required federal goals, rules and regulations.

GEOGRAPHICAL AREA SERVED

Located in the City of Cleveland and operating throughout Cuyahoga County, GCRTA's service spans 457 square miles, operating throughout 59 municipalities, consisting of 38 cities, 19 villages, and 2 townships. GCRTA services an area of 1.26 million residents, with 47 million trips annually.

GCRTA provides 60 routes of bus service for more than 37 million annual riders, spanning over 10 million revenue miles, using a fleet of 428 buses, 39 rapid transit vehicles (RTV's) and 70 Paratransit vehicles. In addition to bus service, GCRTA uses Bus Rapid Transit (BRT) service, consisting of 2 routes, with 13.4 miles of bus-only lanes, providing 5 million rides annually. In addition, GCRTA provides downtown trolleys that service the central business district. Trolley service consists of 4 routes, using 17 vehicles, servicing 1.5 million annual riders.

GCRTA Service Area Map



GCRTA operates Ohio's only rapid transit rail service, including both heavy and light rail trains. The rail fleet contains 60 heavy rail and 48 light rail cars. Rail service consists of four (4) lines: Red (heavy rail) and Blue, Green, and Waterfront (light rail), with a total of over 34 miles of track, and 3.3 million revenue miles. In 1968, Cleveland was the first American city to connect its downtown district to its airport via rail rapid transit. In 1996, RTA completed a light rail transit extension from its downtown terminal to the lakefront and the attractions located there.

Although the American economy has progressed toward recovery, the Greater Cleveland region has been slower to rebound. Cleveland can be considered two cities - a growing city, where the downtown district and select neighborhoods are thriving, and a city where the less fortunate are not connected, have lower educational attainment, and in most cases are unable to fill the requirements of the jobs of the future. While millennials and empty-nesters are the fastest growing segments in the developing sectors, Cleveland has neighborhoods where there is little hope for a positive future, crime rates are higher, and residents fear for their safety. Large vacant areas created by the mortgage foreclosure crisis, are blighting influences on neighborhoods, preventing businesses from making investments. Some of the socioeconomic and environmental challenges include:

Population loss: Cleveland, once the fifth largest city in America, now ranks 45th in population.[3]

Job Loss: Once a power house for manufacturing jobs, since 1960, the City of Cleveland has lost a significant amount of its manufacturing jobs, as companies have moved to suburban areas and other parts of the nation and the world. Over the past 26 years, Cleveland lost about 50% of its manufacturing employment. Job loss was far more severe than the 21.1% loss for the nation as a whole. These jobs have not been fully replaced by equally high-paying jobs in growing sectors of the economy.[4]

Unemployment & Poverty Rates: The 2014 American Community Survey (5-yr estimates) data indicates that Cleveland's unemployment rate is 19.2%, compared to the national unemployment rate of 9.2%[5] U.S. 2010 Census data indicates that 35.4% of Cleveland residents live below the poverty level, compared to the national average of 15.4%[6] and according to the American Community Survey 5-Year Estimate, 36.2% of

[3] Cleveland City Planning Commission, Retrieved 5-25-17, From: http://planning.city.cleveland.oh.us/cwp/pop_trend.php
[4] Once a powerhouse, Cleveland reeling from loss of manufacturing might, Pittsburgh Post-Gazette, Retrieved 6-1-17, From: http://www.post-gazette.com/local/region/2016/07/03/Once-a-powerhouse-Cleveland-reeling-from-loss-of-manufacturing-might-Republican-convention/stories/201607010200
[5] American Community Survey, Retrieved 6-1-17, From: http://factfinder.census.gov

[6] United States Census Bureau Quick Facts, Retrieved 2-25-17, From: https://www.census.gov/2010census/popmap/

Cleveland residents live below poverty level.[7] The median household income (in 2015 dollars) is $26,150.00, compared to the national average of $53,889.00.[8]

Educational Attainment: 2010 U.S. Census data indicates that only 77.4% of Cleveland residents have obtained a high school diploma, compared to the national average of 86.0% and that the percentage of Cleveland adults holding a bachelor's degree is 15.6%, compared to the national average of 29.8%.[9] More education generally translates to higher income, and in turn enables employers to provide an array of important services for all of its residents. With higher educational rates, Cleveland assets such Cleveland State University, The Cleveland Clinic, and the institutions at University Circle, including University Hospitals and Case Western Reserve University, could be better capitalized upon.[10]

Air Quality: Cleveland's historical reliance on manufacturing, heavy industry, electricity generation from coal, and single-occupancy vehicles has contributed to ongoing air quality issues. The Cleveland metropolitan region remains in Nonattainment for four of the six National Ambient Air Quality Standards (NAAQS): ground-level ozone, lead, fine particulate matter ($PM_{2.5}$), and sulfur dioxide. Furthermore, concentration levels of the two pollutants most closely linked to mobile emissions – ozone and fine particulate matter – have fallen by a smaller margin than lead and sulfur dioxide.[11] Cleveland's persistent air quality problems appear more acute when compared to Ohio's three other largest cities: Cincinnati, Columbus, and Toledo. Three-year ozone concentrations for the Greater Cleveland region remain above the 2008 ozone NAAQS (75 parts per billion (ppb)) and considerably above the new 2015 ozone NAAQS (70 ppb).[12] Cleveland is also the only region in Ohio, and just one of nine in the nation, to be in Nonattainment for the 2012 $PM_{2.5}$ NAAQS (12 $\mu g/m^3$).[13] Given the relationship between mobile emissions and ozone and $PM_{2.5}$ concentrations, transportation is a major contributor to Cleveland's air pollution. In Cuyahoga County, 64% of emissions come from mobile sources (vehicles). From 1990 – 2010, the Cleveland area experienced a 17% decrease in ozone air quality.[14]

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[7] U.S. Census Bureau, American Fact Finder, Retrieved 5-25-17, From: http://factfinder.census.giv/faces/nav/jsf/pages/community_facts.xhtml
[8] U.S. Census Bureau, QuickFacts, Retrieved 5-25-17, From: https://www.census.gov/quickfacts/table/EDU635215/3916000,00
[9] U.S. Census Bureau, QuickFacts, Retrieved 5-25-17, From: https://www.census.gov/quickfacts/table/EDU635215/3916000,00
[10] Cleveland City Planning Commission, Retrieved 1-27-16, From: http://planning.city.cleveland.oh.us/cwp/pop_trend.php
[11] NOACA, *Air Quality Trends and Nonattainment Status for Northeast Ohio: 2015 Update* (retrieved 1.26.2016 from http://noaca.org/modules/showdocument.aspx?documentid=11187
[12] Cleveland is also the only one of the three cities that has been in Nonattainment for carbon monoxide (CO), another pollutant closely linked to mobile sources. Cuyahoga County was a Nonattainment area for the 1971 CO NAAQS until 1994

[14] Northeast Ohio Areawide Coordinating Agency, Retrieved 1-30-16, From: http://www.noaca.org/modules/showdocument.aspx?documentid=606

Yet despite Greater Cleveland's reputation as a "rustbelt" city, indicators illustrate that a turnaround in economic growth is taking place. The downtown Cleveland neighborhood has experienced an increase in commercial and residential development. Examples of recent projects include the $465 million Cleveland Convention Center and Global Center for Health Innovation, opened in 2013,[15] as well the $272 million Hilton Cleveland Downtown, adjacent from the Convention Center, opened in 2016.[16] The Flats East Bank Project, a mixed use district that includes commercial, retail, and residential properties, opened in 2013. Situated on 20-acres along the banks of the Cuyahoga River and Lake Erie, over $500 million was invested to redevelop the land, making it a destination neighborhood.[17]

Currently under construction on Cleveland's east side, the East 22nd Street Project will create a new north-south "Main Street" in the Campus District, linking Cleveland State University, St. Vincent Charity Medical Center, and Cuyahoga Community College, to 125 new units of mixed income housing. The investment of $4.2 million includes new paving and streetscapes, with planted medians and bike and pedestrian amenities.[18] And on Cleveland's west side, the Gordon Square Arts District recently completed a $30 million capital campaign that includes new streetscape, signs, parking, and a renovated historic theatre.[19] The neighborhood continues to grow, with no signs of slowing.

In addition to commercial development, Cleveland's residential downtown population continues to grow. Over the past 6 years, downtown Cleveland has maintained an average occupancy rate of 95%, while adding over 2000 housing units to the market. During the same time, the downtown population has increased from less than 9,000 residents to nearly 14,000 residents today, and is projected to reach 16,000 residents by early 2018.[20] If development continues at its current pace, downtown Cleveland will easily meet its goal of reaching a population of 25,000 by the end of 2020.[21]

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[15] Cleveland Convention Center and Global Center for Health Innovation Cleveland, Ohio, Project Management Consultants, Retrieved 6-1-17, From: http://www.aboutpmc.com/Cleveland-Convention-Center-and-Global-Center-for-Health-Innovation/

[16] Cuyahoga County, Ohio, Hilton Cleveland Downtown – Convention Center Hotel, retrieved 6-1-17, From: http://www.cuyahogacounty.us/en-US/Cuyahoga-County-Convention-Center-Hotel-Project.aspx

[17] Cleveland Development Advisors, Retrieved 6-1-17, From: http://www.clevelanddevelopmentadvisors.com/en/Projects/Flats-East-Bank-Phase-I.aspx

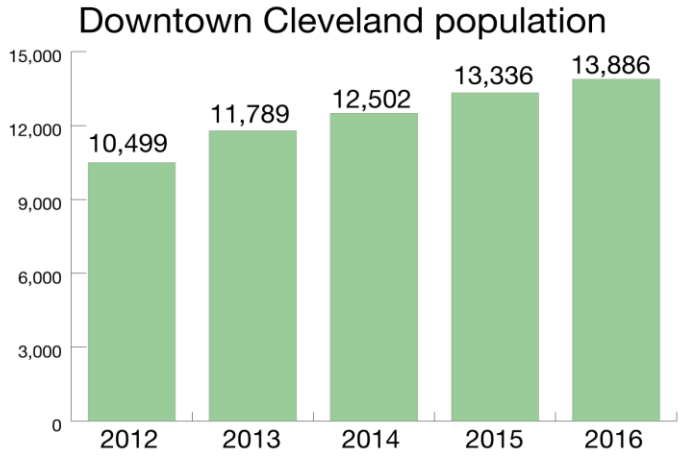
[18] Downtown Cleveland Alliance, 2016 Downtown Annual Report, Retrieved 6-1-17, From: http://www.downtowncleveland.com/getmedia/22505da6-269e-4826-862f-25d35e253164/DCA_AnnualReport2016_Spreads

[19] Cleveland.com, The Gordon Square Arts District finishes its $30 million capital campaign - and launches a new master plan , Retrieved 6-2-17, From: http://www.cleveland.com/architecture/index.ssf/2014/09/the_gordon_square_arts_distric.html

[20] Downtown Cleveland Alliance, Q1 Downtown Cleveland Market Update, Retrieved 6-2-17, From: http://www.downtowncleveland.com/DCA/media/DCA_Media/Work/Reports/Q1-2017-Market-Update-2017-spreads.pdf

[21] Cleveland.com, How downtown Cleveland is changing by the numbers, Retrieved 6-2-17, From: http://www.cleveland.com/datacentral/index.ssf/2016/05/how_downtown_cleveland_is_chan.html

Prior to 2007, surveys show Cleveland was actually experiencing "brain drain", with college-educated millennials leaving the area. But a recent study conducted by The Center for Population Dynamics at Cleveland State University reveals that Cleveland tied for eighth in the nation (along with Miami and Seattle) in the percent increase of college-educated millennials. The study also shows Cleveland ranked eighth nationally in the concentration of highly-educated millennials in the workforce (those with a graduate degree). The launch of Cleveland's millennial migration coincides with the start of the Great Recession (2008-2010) and continued through the post-recession (2011-2013). A recent study cites that the tremendous growth Cleveland and other "rustbelt" cities, such as Detroit and Pittsburgh, have enjoyed during can be attributed to numerous factors, including the cost of living. Beyond the so-called "brain gain", the statistics show a higher concentration of millennial residents overall, regardless of education. In 2013, 24 percent of Greater Cleveland's population was comprised of millennials (ages 18-34), up from 20 percent in 2006.[22]

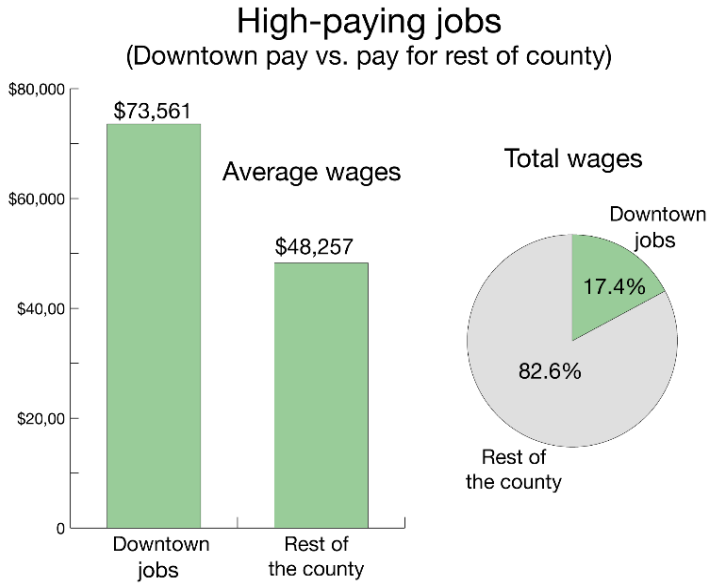


Millennials make up 52% of GCRTA's overall ridership[23], and according to a survey released by the Rockefeller Foundation, nearly half (46%) of millennials surveyed said that they would rely on non-driving modes of transportation more heavily, if presented with good options.[24]

There are more than 130,000 office workers in greater downtown Cleveland, with nearly 7,000 jobs that have been added since 2011. Downtown Cleveland accounts for 1 in 6 of the jobs in Cuyahoga County, and these downtown jobs are among the highest paying. Average pay for downtown workers of $73,561.00 is well above the county

[22] Cleveland Foundation, Cleveland ranks among top 10 U.S. cities for population growth of college-educated millennial residents, Retrieved 6-2-17, From: https://www.clevelandfoundation.org/news_items/millennial-residents/
[23] GCRTA 2013 On-Board Transit Survey
[24] U.S. PIRG, Don't Believe the Hype – Millennials Transportation Habits are Changing, Retrieved 6-2-17, From: http://www.uspirg.org/blogs/blog/usp/don%E2%80%99t-believe-hype-%E2%80%93-millennials%E2%80%99-transportation-habits-are-changing

average of $48,257.00. The wages earned downtown account for 17.4 percent of the wages countywide.[25]



Estimates indicate that on average, a Cleveland area resident can save $920.00 per month, an annual savings of $11,141.00, by utilizing public transit.[26] With downtown Cleveland reflecting national trends toward a younger, more environmentally conscious workforce and population, access to public transit has become an important factor in retaining talent and encouraging residential and business growth in urban cores, making funding of public transportation a critical issue to sustain economic viability of the Greater Cleveland region. A safe and reliable transit system that provides timely communication to its customers will ensure GCRTA's ability to deliver the needed services.

REAL WORLD ISSUES AND CHALLENGES

GCRTA's greatest challenge is its aging infrastructure and outdated technology. GCRTA's current transportation communications infrastructure is obsolete, as it has reached the end of its useful life. Due to budgetary constraints, GCRTA has been unable to invest in upgrading bus and rail communications systems with 21st century technology. The existing antiquated technology prevents being able to exchange information in real-time to stakeholders, resulting in poor communication and inefficient data collection. The antiquated technology hinders GCRTA's ability to deliver basic services to those dependent on public transit.

GCRTA's current radio system was installed in 2001, using enhanced digital access communication system (EDACS) technology. At the time of installation, EDACS

[25] How downtown Cleveland is changing: by the numbers, retrieved 5-30-17, From: http://www.cleveland.com/datacentral/index.ssf/2016/05/how_downtown_cleveland_is_chan.html
[26] American Public Transportation Association, retrieved 6-2-17, From: http://www.apta.com/mediacenter/pressreleases/2015/Pages/150528_Transit-Savings.aspx

technology was in the middle to late periods of its life cycle and is now obsolete. The majority of mobile equipment and radios cannot be repaired, because parts are no longer manufactured. Some repairs are made with used and/or cannibalized parts from other out of service units. Critical tower parts cannot be replaced in the event of a failure. In the past two (2) years, GCRTA purchased used equipment from other transit properties that have replaced their radio systems, as well as purchasing parts as needed from internet sites.

When one component of the radio system fails, it can cause other components to fail as well, creating major safety issues. GCRTA relies on the radio system to support the computer aided dispatch and automatic vehicle locator (CAD/AVL) system. Without a functioning radio system, GCRTA is unable to visually see or communicate with bus and rail operators. In 2016, GCRTA had a major radio failure, resulting in the rail system being non-operational for two (2) days, resulting in a complete system-wide shut-down of rail service.

To prolong the life of the current radio system, GCRTA hired a radio maintenance vendor to perform preventive maintenance, equipment repair, and troubleshooting (emergency callout). With the vendor's assistance, GCRTA can temporarily maintain the system more effectively. However, hardware still continues to fail. Without a radio tower expert, the authority is at risk of a complete radio failure. The table below details the current state of GCRTA's radio communications system.

Table 1: GCRTA'S CURRENT RADIO SYSTEM

Part Description	Repairable	Spares	Estimated Expected Life	Organizational Impact
IVLU	No	Few	3	No data collection, announcements, etc.
Radio	Sometimes	Few	3	No communication
Access Points	No	4	2-3	No vehicle will get the schedule
Radio Tower Parts	Sometimes	Few if available	2-3	Poor/Failed Communication
OnStreet Signs	Yes	3	Trapeze will repair	No Real-time information

GCRTA is limited due to the following:

1) GCRTA uses a CAD/AVL system, in conjunction with GCRTA's radio system, to track vehicles, monitor of on-time performance, and communicate with operators. The capabilities of CAD/AVL system are limited, as it lacks the capability to interface with any other computer systems. As a result, information cannot be provided in real-time
2) Fuel economy is measured using static reports, with no indication for improving fuel economy and emission reduction;
3) There are no navigation devices on GCRTA vehicles and operators must rely on hard copy route books
4) GCRTA uses camera software to monitor operator performance, with two cameras on board each bus. Hard braking, fast turns, etc. are measured using CAD/AVL software that cannot be integrated with any other software applications
5) GCRTA can only provide text message updates for rail delays; lack of technology prevents GCRTA from being able to provide text message updates for bus service. Therefore any route detours or service delays cannot be communicated in real-time
6) Current community information is shared using static media and is updated manually
7) Updating ADA announcements is a cumbersome and time consuming process;
8) Vehicle inspections are performed manually and tracked using a paper card system
9) There is currently no wireless connection access available to passengers on any GCRTA vehicles

DESCRIPTION OF TRANSPORATION SYSTEMS AND SERVICES

Real-time data is key to making public transportation a choice for those with options. Replacing GCRTA's antiquated radio and CAD/AVL systems is paramount to making GCRTA the transportation of choice. The integration of new systems will determine how data transmits from GCRTA to passengers, municipal government, and businesses throughout Greater Cleveland. Systems upgrade will allow GCRTA to provide data on the coordination of bus routes and schedules, deployment of vehicles in the event of an unforeseen disaster, and public alerts to passengers, pedestrians, and drivers when public safety is at stake.

Table 2 outlines a description of each component, its current technology, and a description of the enhanced technology that will be implemented.

Table 2: TECHNOLOLGY COMPONENTS: CURRENT AND PROPOSED

Component	Current Technology	Enhanced Technology
Vehicle Alarms	"Covert" and "overt" alarms on buses communicate with the Integrated Communications Center (ICC) for emergencies; overt alarms are for situations such as medical issues or mechanical failures. Covert alarms are silent and only used when danger is imminent. Communication is solely audio, with no visual component	Enhanced onboard technology will stream video, allowing ICC and Transit Police hear and see inside the vehicle
Emission Tracking	GCRTA analyzes fuel economy for vehicles, but data is static, without indications on how to improve fuel economy and reduce emissions	Maintenance software and sensors are installed and/or interfaced on each vehicle can monitor fuel emissions through fuel economy and operator performance The fuel economy and emissions are monitored/recorded in addition to the operator behavior

ADA Announcements	ADA audio announcements are provided, but are labor intensive and time consuming to update	Onboard audio announcement will be updated for passengers, as well as those waiting to board; messages available in multiple languages
Turn-by-turn Navigation	There are currently no navigation devices on vehicles; route training is only conducted on fixed routes and there is no route training for Paratransit routes	Software will be installed on all vehicles, improving operator and rider safety, identifying correct streets (reroutes, special events), for all routes, including Paratransit; the navigation provides turn-by-turn instructions for each operator
Real-Time Information	RTA currently provides real-time information for rail only; however, each vehicle is polled every minute creating a lag in information to customers	Software will provide passengers real-time vehicle information including live tracking and estimated departures from specific stop locations; the new IVLU polls satellites and provides updates every 15 seconds (compared to 1 minute); for riders without smartphones, RTA will implement LCD screens at key locations
Vehicle Maintenance	Paper "pre-trip" inspection card are used for each trip, identifying critical safety issues and damage to the vehicle. Information is tracked manually; no monitoring tools to assist management for predictive maintenance	Vehicle checklist is conducted using onboard tablet, replacing paper card; software monitors vehicle for issues, such as low fluid
Wi-Fi	GCRTA does not currently does not provide Wi-Fi	Passengers will enjoy complimentary onboard Wi-Fi

Travel Time	Vehicle travel time is logged through monitoring recorded data and surveying; field work conducted to identify needs to increase/reduce travel time between buses and record passenger loads	Will monitor travel times and identify areas to improve on-time performance for riders, automatically notifying passengers when a bus/train is off schedule
Service Quality: Field Supervision	Supervisors throughout the county monitor service, assist operators, and answer customer questions; few supervisors have laptops installed in their vehicles to track bus arrivals and departures; supervisors can answer customer questions, but cannot always provide real-time information regarding service; driver behavior is recorded manually input into a database at a later time	Field supervisors will use tablets to record and communicate in real-time. They can track vehicles, monitor on-time performance, submit coaching/accommodations, and communicate with operators in real-time

DEPLOYMENT PLAN AND LONG-TERM OPERATION & MAINTENANCE

In 2015, GCRTA developed an Intelligent Transportation Systems (ITS) department to manage and implement applications and technology relating to the delivery of service. The ITS department specializes in researching, implementing and enhancing technology and currently supports software to manage the authority's inventory levels, daily vehicle/facility maintenance, operator schedules and performance, vehicle and route scheduling, vehicle GPS, vehicle performance standards, and radio system.

To evaluate the replacement communications system, GCRTA has contracted with IBI Group to conduct a study to identify the best approach for implementation of systems upgrade that meets operational needs. GCRTA will evaluate each solution and make a selection so the project is "shovel ready" when funding is available.

IBI Group has five (5) tasks to complete. Tasks include:

Task 1: Identify radio replacement opportunities and methods

Review and analyze various communication systems: Each system must be compatible with GCRTA's operations, and support both voice and data communication. Examples of radio solutions include, but are not limited to: traditional voice and data radio, traditional voice and cellular data, and cellular voice and data. Vendors will detail short and long-term benefits of each system.

Task 2: Develop a SWOT and Gap Analysis for each method

Develop a SWOT and GAP analysis for each system: The GAP analysis will compare the current system with potential future systems.

The analysis must include, but is not limited to:

1. System infrastructure
2. On-going maintenance
3. User interfaces
4. CAD/AVL and radio integration
5. System administration and monitoring
6. Voice and data communication
7. Reliability of data and voice coverage
8. Training
9. Equipment needs (portable radios, cell phones, etc.)
10. Lifecycle replacement schedule and expense
11. Equipment and parts availability

Task 3: Perform a voice and data coverage analysis for each method

Perform a coverage analysis for each communication system: The recommended system must have sufficient coverage to provide reliable and clear communication for vehicles operating throughout Cuyahoga County. The analysis must include, but is not limited to:

1. Tower density
2. Tower location
3. Tower space availability
4. Maintenance or lease expenses for towers
5. Available vendors to install and support the tower space

Task 4: Develop a cost/benefit analysis for each method

Develop a cost/benefit analysis to determine both the monetary and opportunity expenses: The analysis will include, but is not limited to:

1. Initial Backend Hardware Expenses
2. Onboard vehicle Expense
3. On-going maintenance expense (annual)
4. Life-cycle Replacement costs (onboard and backend)
5. Communication benefits (voice and data)

Task 5: Provide a final recommendation

Based on tasks 1-5, provide a final recommendation: The recommendation will detail the communication system features and the reasons why it is best aligns with GCRTA's needs. The final recommendation will outline the process to procure and implement the recommended communication system.

CHALLENGES AND OBSTACLES TO DEPLOYMENT

Table 3 represents the SWOT (strengths, weaknesses, opportunities, and threats) analysis to be considered with implementation of a new communications system.

Table 3: STRENGTHS, WEAKNESSES, OPPORTUNITIES THREATS (SWOT) ANALYSIS	
Strengths • Dedicated ICC for bus and rail • Experienced team members • Improved Service Quality department staffing level • Dedicated implementation team • Dedicated electronic repair and ITS departments to manage system	Weakness • Current radio infrastructure requires full replacement • Will need to run dual communication systems during upgrade
Opportunities • New ITS applications and rider benefits (real-time information, navigation) • New hardware technology (e.g., tablets, cell phone communication) • Real-time data entry and management for improved on-time performance • Connected ITS applications (interfaces) • Improved radio coverage across county • New safety features for operators	Threats • Aging radio infrastructure will continue to fail • Time – new system will not be fully implemented until 2021

QUANTIFIABLE BENEFITS

GCRTA will use quantitative performance measures to determine the ATCMTD's impact on improved safety, enhanced mobility, and climate change, and will partner with both Cleveland State University's University Transportation Center (CSU-UTC) and Case Western Reserve University's Department of Civil Engineering to evaluate measurements before and after implementation of proposed technological upgrades.

GCRTA currently utilizes a performance monitoring program known as TransitStat, a structured continuous management program that entails the frequent gathering, reviewing, and analyzing of day-to-day performance. TransitStat is GCRTA's adaptation of the New York City Police Department's CompStat and the City of Baltimore,

Maryland's CityStat. TransitStat uses information systems to define, measure, analyze, improve, and control operations functions.

Since 2008, TransitStat has:

- Encouraged data-driven decision making
- Identified cross-functional gaps
- Identified latent operational issues
- Identified negative trends early
- Created a solutions-based culture

Using TransitStat, GCRTA experienced over $78.1 million in cost savings since 2008. See the enclosed informational document for a comprehensive list of cost and other qualitative savings relating to GCRTA's TransitStat program.

In addition to TransitStat, GCRTA's TEAM (Together Everyone Achieves More) initiative is a labor-management sponsored employee program designed to reward all employees for their contribution to reaching the goals that drive the GCRTA Business Plan. The program is committed to recognizing, reinforcing and rewarding employees for improvements, resulting in increased revenue, profitability and growth. See the enclosed informational document detailing GCRTA's 2017 TEAM results.

QUANTIFIABLE SYSTEM PERFORMANCE IMPROVEMENTS

GCRTA will measure the following to determine performance improvement:

- On-time performance: sensory technology will measure on-time performance in real-time and allow customers to monitor travel time; software will identify areas for improvement in on-time performance;
- Accuracy of real-time information: software will allow GCRTA, as well as its passengers, access to real-time travel information; custom text messages will be created in real-time and disseminated via text and e-mail, and at rapid stations and transit centers;
- Reduction of road calls due to mechanical defects: implementation of software for planned maintenance will reduce the number of breakdowns, improving fleet reliability;
- Automated passenger counters (APC): installation of APC's will measure passenger loads on all routes and will be used to effectively plan schedules;

QUANTIFIABLE SAFETY, MOBILITY, & ENVIRONMENTAL BENEFITS

Installation of an upgraded communication system will enable GCRTA to better monitor driver's performance, including preventable collisions and fuel emissions. Vehicle operator information will automatically interface with CAD/AVL and BID Dispatch software (used for operator scheduling), accurately communicating driver's performance in real time, as well as monitoring fuel emissions through usage of software and sensors installed on each vehicle.

VISION, GOALS, AND OBJECTIVES FOR TECHNOLOGY DEPLOYMENT

GCRTA implemented an ICC Modernization Program to support replacement of the current CAD/AVL equipment and radio system. The program's goal is seamless integration of new software with existing technology that is currently in place.

GCRTA's Service Quality department currently includes the Integrated Control Center (ICC) that manages bus and rail service twenty-four hours per day, seven days a week and relies on technology and software applications (using multiple ITS applications). The ICC Modernization Program function is to review, analyze and enhance the use of ITS applications to support Service Quality's operation (ICC and field supervision). The ICC Modernization Program's group consists of related projects that are coordinated simultaneously or systematically to achieve a specific goal. The project team will systematically review each of the following:

1. Enhancing the use of ITS applications
2. Reviewing and re-engineering business processes
3. Improving internal and external communication
4. Training and accountability

Maintaining the nation's bus and rail systems in a state of good repair (SOGR) is one of highest priorities for both the Federal Transit Authority's (FTA) and GCRTA. An asset is considered to be in a state of good repair if it is safe, reliable, and keeps the customer satisfied. As previously stated, the CAD/AVL software and radio system have reached the end of their useful life and therefore cannot be considered to be in a state of good repair. Funding for the CCP will allow GCRTA to accomplish each of the project goals listed, providing a new backbone to the communications system.

A communications system that can provide real-time information to both GCRTA and the public is essential for delivering safe and reliable transit service to thousands of daily riders, in order to maintain public transportation infrastructure into the 21st century. As Ohio's largest transit system, having a reliable communications system is imperative to the continued successful operation of GCRTA's bus and rail service. In order to avoid delays and shutdowns, existing technology must be upgraded.

PLAN FOR PARTNERING WITH OTHER ORGANIZATIONS

GCRTA will partner with both Cleveland State University – University Transportation Center (CSU-UTC) and Case Western Reserve University's (CWRU) Department of Civil Engineering to provide training, education, outreach, and research focused primarily on transit issues and highway construction safety. Operating since 2005 the CSU-UTC is a long term initiative that taps the research and educational expertise faculty from several colleges (the *Washkewicz College of Engineering*, the *College of Education and Human Services*, and the *Levin College of Urban Affairs*) across the campus. Its goal is to improve all facets of transportation across the region. CSU-UTC's letter of support dated June 9, 2017 has been included with the grant application.

Case Western Reserve University's *Richard '39 and Opal Vanderhoof Infrastructure Research and Education Facility* and *William H. Schuette '33 Structural Laboratory* are premier facilities for large-scale structural testing. They are used for both education and research on the performance of large-scale infrastructure components. It is available for use by academic researchers, industry, and governmental agencies. CWRU's letter of support, dated June 7, 2017, has been included with the grant application.

PLAN FOR OPTIMIZATION OF EXISTING ADVANCED TRANSPORTATION TEC

As an integral institution of Greater Cleveland, GCRTA will utilize all its assets (fixed and mobile) to record and communicate information. GCRTA has more than 400 vehicles on the road during peak service and operate vehicles throughout Cuyahoga County twenty-four (24) hours per day, seven (7) days per week. Vehicles will act as data hubs, sending and receiving information. In addition to GCRTA's standard onboard equipment, additional equipment can be added to record other data needs.

Advanced transportation technology that will be implemented include:

- Emissions tracking
- Traffic patterns and congestion area tracking
- Road and weather condition monitoring
- Travel information: locations where passengers board and their destination
- Real-time information on mobile apps, restaurants, and businesses

DEPLOYMENT SCHEDULE

Table 4 contains deployment milestones and corresponding dates for systems upgrade and replacement. Note that a more detailed deployment schedule has been included with the grant application.

Table 4: Deployment Schedule

Task	***Start Date***	***Completion Date***
Project kickoff meetings	7-2-18	7-6-18
Project initiation – schedule deployment	7-9-18	8-3-18

Preliminary design review – develop equipment list, plan for removal of existing equipment and new installation, software design and interface plan, radio design & transition plan, system integration & acceptance testing, data migration & backup	9-3-18	9-28-19
Final design review, signoff	10-1-18	11-30-19
Software and hardware customization/ factory testing, procure mobile equipment, fixed equipment, fixed equipment, radio & tower equipment, test hardware & software	1-7-19	10-11-19
Software and hardware field testing, systems integration testing, mobile rollout and cutover, radio rollout and cutover, radio coverage testing	10-28-19	7-17-20
System training	7-27-20	11-6-20
System availability and test approval	11-9-20	1-8-21
Project closeout	1-11-21	4-2-21

INNOVATIVE TECHNOLOGY INITIATIVE

GCRTA will partner with both Cleveland State University's University Transportation Center (CSU-UTC) and Case Western Reserve University's (CWRU) Department of Civil Engineering to leverage best industry practices during the planning and execution of the project.

CSU-UTC has conducted research studies that utilize sensor data acquired from rapidly-deployable road-side sensors to characterize and measure traffic and driver behavior. These research studies have shown feasibility of using road-side sensors to compute traffic density and flow data, and to use such data to predict traffic flow and density downstream. Such data can also be used to create models for re-routing traffic in real time. CSU-UTC will use these capabilities in the implementation of preemption systems in a manner such that the priority vehicles are able to traverse the city as quickly as possible, while still creating an environment where the impact on the general public is minimized.

CWRU utilizes a state of the art driving simulator. Simulators are used for research in the areas of transportation safety improvement, driver cognitive feedback, human factors, human machine interfaces, rehabilitation, prosthesis, etc. The simulator is a fully integrated, high performance, economic, and high fidelity driving simulation system, designed for use in ground vehicle research and training applications.

GCRTA will work with CSU-UTC and CWRU to adapt the available technology to increase safety, provide real-time information, and implement real-time communication.

II. Staffing Description

[redacted]

[redacted]