Montgomery County
Bus Rapid Transit System
Information Technology Needs

Department of Technology Services
Department of Transportation
Montgomery County Government, MD

3/7/2012

VERSION	DATE	DESCRIPTION
1.0	21 December 2011	Document Created
1.1	28 December 2011	Comments from CIO and Network Service Mgr
1.2	19 January 2012	Include information received from DOT and DGS. Added additional cost estimates
1.3	17 February 2012	Incorporate DOT and DTS comments
FINAL	7 March 2012	DOT Final Comments

1.0 Introduction

1.1 Scope of problem and priorities

The purpose of this document is to begin tracking the Bus Rapid Transit (BRT) System Information Technology needs. These needs will come in a number of categories with the Department of Technology Services (DTS) directly involved in some and functional owning departments in others. This document will attempt to identify the areas DTS will be involved, areas where it can take ownership, and areas covered by functional departments.

Where DTS has ownership DTS will identify assumptions, open questions and with enough information develop cost estimates.

Finally, DTS is always ready to help with reviews and offering guidance with regards to general IT issues affecting this project.

1.2 References

1. Montgomery County Department of Technology Services; *Montgomery County Government Enterprise Architecture;* March 16, 2011;
2. MCG Department of Transportation; Countywide Bus Rapid Transit Study, Consultant's Report (Final); July 2011

2.0 Technical Responsibilities

2.1 Assumptions

At this point in time the following assumptions are being made in the following areas:

2.1.1 General Assumptions

The BRT system will make use of the following current Ride On systems:

- Trapeze for bus scheduling

- CAD/AVL for command and control

- Current UHF (450-490MHz) network for audio and data communications

  1. 3 Transmit/Receive remote radio sites
  2. 3 Receive only remote radio sites
  3. Each radio site has 3 analog Quantar base stations dedicated to voice
  4. Each radio site has 2 analog Quantar base stations dedicated to data
  5. base stations have been narrow-banded to 12.5 KHz channels per FCC mandate (must be completed by Jan 1, 2013)
  6. Voice traffic is currently at levels well within the capacity of the 3 voice Channels available
  7. Data traffic is currently at levels well within the capacity of the 2 data Channels available

- Current (one being deployed now) SmartTraveler Customer Information system

- On board cameras will be supported through current Ride On processes and systems and will not require real-time connections to the buses

There will not be a Supervisory Control and Data Acquisition System (SCADA) that controls the buses along the route.
- If there is a bus control system at a station that guides the bus to a predetermined stop point at the station it will be through a vendor closed system.
- The closed system may use communications at the bus stop to communicate outside the station but will not have real-time, life dependent requirements

Fares will not be collected on the buses operating in peak periods. On board fareboxes may be used during off-peak periods and at low ridership stations.

The payment system in each of the Bus Stations will be a Metro System
- The payment machines in the stations will accept credit cards and cash.

Buses will have on-board cameras

There will be 100 to 150 new BRT stations that include 367 platforms
- Station can be two platforms separated by the street/highway

The current Ride On UHF (450-490MHz) system needs improved coverage in the east County area.

Additional UHF channels (frequencies) will be needed to support data. Approximately one additional channel for every 175 buses added to the fleet. The number of net new buses is uncertain until specific corridors are advanced and operating plans are developed. It is expected that some Ride On buses may be replaced with BRT vehicles.

The BRT buses will be maintained with current Ride On depots
- One new depot will be built

The Traffic Signal Priority (TSP) system will be a system between the bus and the individual traffic controllers at each intersection
- The interface will be between DOT Ride On and DOT Traffic

2.1.2 Communications Network

Facilities

New FiberNet connections will need to be installed at each of the new stations and the new depot. Each station will require a LAN.

Depots supporting the new BRT buses may need some wireless infrastructure work to support new areas of the facility as well as newer load requirements.

Vehicles

Any communications will either be through existing means:

- UHF
- Download or upload at the depot

Or will be through a wireless (cell) vendor connection directly to their equipment (ie TV programming).

Ride On UHF (450-490 MHz) System

Network requires coverage improvement, especially in the east County.

At this time DTS is assuming that Ride On will need from 3 to 5 new sites

- To adequately design radio system coverage requires complex design using highly specialized coverage design software. A host of parameters must be taken into account based on user coverage requirements and whether the RF system will be an integrated voice and data system or two separate systems, etc. Likewise the choice of base station technology would dictate the need for more or less numbers of radio sites given the same coverage requirement. (i.e. Linear simulcast modulated base stations need closer site deployment to garner their improved operations over the same coverage area as the older modulation schemes operating currently.

Ride On we will need additional data channels to handle the increased number of buses in the fleet.

The County does not have unused licenses in the UHF band. These would have to be requested through application and subsequently awarded by the FCC. Each new channel would then require six new base stations, one at each of the six remote radio sites, to maintain the same level of coverage that is currently available. Should increased coverage be required, this would have to be designed and could take the form of enhancing current sites, leasing new sites or adding bi-directional amplifiers (BDAs) at key geographical locations within the County. Each new site deployed, would require a full compliment of base stations to enable that site to carry all the channels available to users. The only exception to this full compliment of base stations at a new radio site, would be deploying BDAs for "in-fill" coverage in particular areas such as down by the Potomac and in other such "coverage holes".

Bus Stops/Transit Centers

150 new BRT stations with 367 platforms
- Station can be two platforms separated by the street/highway

Each station will need a connection to FiberNet

Each station will require a Local Area Network

The network components will require at least line conditioning equipment and/or 15 minute battery backup.

Supported Systems inside each station –

- Messaging Signs
- Security cameras that can record can be monitored by the Police Security office or by other authorized agency

Each station will have one or more payment machines that will communicate with Metro
- Method of communications is TBD and is dependent on Metro
- Payment machines and all parts of the communications path are subject to PCI compliance

Each station will have security cameras and have a video feed back to some point where the Police Security Team can monitor

Electronic Fare Payment

Fares will not be collected on the buses except for off peak periods and at low ridership stations

Each station will have one or more payment machines

Each machine will take credit cards and cash

Each machine will communicate with Metro

Payment machines and all parts of the communications path are subject to PCI compliance
- Current County Strategy is to not store credit cards and to get Credit Card data out of County control as soon as possible
- Best practice is to have the payment machines and network connection be Metro owned.

2.1.3 Vehicles

Electronic Fare Payment

Each vehicle will be equipped with a farebox

AVL/CAD

New BRT buses will interface to and be controlled by AVL/CAD same as current buses

Automated Passenger Counter

Ride On uses an Automated Passenger Counter for both historical analysis and real time upon request. A data message is sent out to the bus asking for an onboard count and a data message back in with the number of passengers onboard.

The new BRT system will use the current Ride On system.

Video/audio on-board

All vehicles will be equipped with a video/audio recording system with multiple cameras. There are no current plans for delivering video or audio to the onboard passengers.

Stop Annunciator system

New BRT buses will use the current system.

2.1.4 Passenger Information Systems

Signs at Transit Centers/Bus Stops

Information and signs will be interfaced to and be a part of the current DOT Ride On Smart Traveler project.

On-Board

Onboard Next Stop electronic signs and voice announcements are standard on all Ride On buses as part of the OrbCAD system.

Internet/Phone

None on the vehicles. Passengers will use their cell phones.

3.0 Technical Responsibilities

Given the above assumptions DTS at this time would see technical responsibilities as the following:

3.1 DTS

DTS would be responsible for the following areas:

3.1.1 Network

The DTS Networking Team would provide a FiberNet connection to each of the new stations. At each station DTS would provide a LAN network for the devices within the building such as – signs, cameras, etc.

The DTS Network team could support connectivity to the Farecard machines but at the expense of much greater security and compliance requirements for both DTS and Ride on. This is dependent on Metro and its vendor.

3.1.2 802.11 Wireless Network

Based on DOT Ride On requirements the 802.11 wireless network might need enhancements at the new bus depots.

3.1.3 Ride On UHF (450-490 MHz) System

While the UHF network is owned by Ride On they do call on the DTS Radio Shop for help. DTS would work with Ride On to expand their UHF network coverage in the east County area. At this time DTS is using an estimate of 3 to 5 new towers to ensure needed coverage.

Currently, Ride-On radio infrastructure equipment repair is maintained under the Services and Maintenance Contract that covers the Public Safety 800 MHz radio system. Service calls for radio infrastructure are dispatched to County Radio Shop technicians only. Ride-On has "first tier" technicians who can swap out bad bus radios with good ones but anything more involved is also repaired at the Radio Shop. Any new infrastructure would need to be added to the maintenance contract with a commensurate cost attached for this new coverage.

The County does not have unused licenses in the UHF band. These licenses would have to be requested through application and subsequently awarded by the FCC. Each new channel would then require six new base stations, one at each of the six remote radio sites, to maintain the same level of coverage that is currently available. Should increased coverage be required, this would have to be designed and could take the form of enhancing current sites, leasing new sites or adding bi-directional amplifiers (BDAs) at

key geographical locations within the County. Each new site deployed, would require a full complement of base stations to enable that site to carry all the channels available to users. The only exception to this full compliment of base stations at a new radio site, would be deploying BDAs for "in-fill" coverage in particular areas.

To adequately design radio system coverage requires complex design using highly specialized coverage design software. A host of parameters must be taken into account based on user coverage requirements and whether the RF system will be an integrated voice and data system or two separate systems, etc. Likewise, the choice of base station technology would dictate the need for more or less numbers of radio sites given the same coverage requirement. (i.e. Linear simulcast modulated base stations need closer site deployment to garner their improved operations over the same coverage area as the older modulation schemes operating currently.)

3.2 DOT – Ride on

DOT would be responsible for the following areas:

3.2.1 CAD/AVL

Any license and capacity enhancements required to support the additional buses and any upgraded functions

3.2.2 Trapeze Scheduling Software

Any license and capacity enhancements required to support the additional buses and any upgraded functions

3.2.3 Other Licensing

Any Enterprise licensing and capacity enhancements for Ride On to support additional employees. This could mean extra licenses for AD, MCTime, Exchange, Tivoli, etc

3.3 Police – Security

3.3.1 Security Cameras

The Police Security office would specify the required cameras and work with a vendor to install those cameras. The DTS FiberNet connections would be used to bring the video back to the Police Security Office or other Police entity.

3.4 Metro

3.4.1 Farecard Machines

Metro would be responsible for specifying the requirements around the Farecard machines and their connectivity.

If would be easier on the County if the connectivity for the Farecard machines was through Metro and not through County Facilities.

4.0 Additional Considerations

- Stations will not be stand-alone buildings or require phones
- Police own the functional aspects of the security cameras and monitoring process.
    a. DTS can provide connectivity but Police own the camera system
    b. Police need to be part of the work group to design the functional process around monitoring the cameras and any required changes to their system to meet requirements
- Bus routes will not require CCTV
- The number of new employees has not been
    a. Number needed for administration system licenses both within DOT and in the Enterprise (ie MCTime)
- It is assumed that BRT system buses will be maintained through current Ride On bus depots; additional infrastructure at these depots may be required
- It is assumed that Ride On is going to use its current on board camera system. It is not known whether requirements will have to change with this project to accommodate
    a. Additional storage
    b. Records retention changes that will drive the need for greater storage
- It is assumed that the fare machines will be compatible with Metro and could be provided by Metro vendor
- It is assumed that Metro will be responsible for the credit card process within the farecard machines and will use a 3rd party network connection to the farecard machines
- The redundancy requirements for connectivity and power at the stations will need to be determined in terms of the need for
    a. a second network connection
    b. generator and uninterrupted power supply

5.0 Estimates

At this point it looks like DTS will primarily be acting in a supporting role for DOT Ride On and Police security. The main work item for DTS will be providing networking services to each of the new BRT stations as well as coverage improvement and securing and licensing additional data channels for Ride On's UHF network.

The estimate will contain:

1) UHF Network improvements
2) FiberNet connectivity to each of the 150 stations, currently FiberNet is seeing construction costs of $14 to 16 per foot for new construction in surrounding jurisdictions. DTS would anticipate that the fiber placed for the BRT stations would be dedicated to their use exclusively.
3) LAN switch, short term(15 minutes) battery backup and UPS protection for equipment, and cabling within each station, budget estimate for each station including low-voltage cable requirements is $10k to $20k.
4) Estimated license cost for Enterprise systems if Ride On needs to hire a block of new employees

The estimate will not contain how much a PCI compliant connection to Metro will cost, until the Metro connectivity issue is resolved.

The estimate will not contain any 802.11 wireless network upgrades at the depots until the depot requirements are better known.

5.1 Estimate

5.1.1 Ride On UHF Network Coverage Improvement

Radio sites come in a variety of shapes and sizes depending upon the geographic area (urban/rural), the lease, the space and the coverage needs. The first step is would be to undertake a coverage study. This would provide recommendations of where either enhance existing sites or new sites are needed. In addition, "sites" might take the form of a BDA on a pole and this is vastly more cost effective for certain applications than a complete new site. This estimate is based upon a worst case scenario with a cost of a complete antenna site build out.

Base station build out would entail at least 6 new base stations per existing radio site. New base stations estimated cost would be $50K per station. Currently, at least 8 of Ride-On's 30 base stations are reaching their end of life (15 years) and should be replaced as part of on-going network maintenance/enhancement. The remaining (22) base stations are approximately 4 years old and in great condition.

Total Site Cost -

    Base Station immediate upgrade estimated costs $400K
    Base Station augmented channel estimated costs $300K (per channel added)
    Coverage Design with drive test estimated costs $300K
    Additional augmented channel infrastructure to
    Antenna Site estimate $300K (per site)

5.1.2 Station LAN including Fiber endpoint

$10k to $20k per station

Total – $1,500,000 to $3,000,000

5.1.3 FiberNet

$600k-$700k for electronics for the central nodes

$14-16 per linear foot for the fiber to each station

Redundancy – additional 50 miles to form closed loop

Basic Total – 150 miles * 5280 feet = 792,000 feet
    $11.1M to $12.7M

Redundancy total – 50 miles * 5280 feet = 264,000 feet
    $3.7M to $4.2M

5.1.4 Estimate Summary

Item	Low Cost	High Cost
UHF Network Improvement	$1,900,000	$2,500,000
Station LAN	$1,500,000	$3,000,000
FiberNet Central Nodes	$600,000	$700,000
Fiber to each station	$11,100,000	$12,700,000
Fiber redundancy	$3,700,000	$4,200,000
Total	$18,800,000	$23,100,000