# TECHNOLOGY OPPORTUNITIES AND BENEFITS REPORT

## Illinois Statewide Public Transportation Plan

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## I. INNOVATIVE TECHNOLOGIES FOR TRANSIT

### *A. Introduction*

A major topic of interest for both fixed route and demand response transit operators is the potential for increasing the amount of technology used to support transit operations and to make it easier for potential passengers to use. While increasing the deployment of technology on transit systems in the state has been called out as a goal of its own, it is important to understand the benefits which will result. This paper discusses the types of technologies that are available for fixed route and demand response transit services, identifies which transit systems in the state are utilizing the various technologies, and makes recommendations on policies IDOT could adopt to speed the implementation of technology in transit.

### *B. Urban Fixed Route Systems*

The types of technologies available for urban fixed route systems are described below. In describing these technologies, it is important to understand:

- *What the elements of technology for fixed route transit systems are*
- *The benefits each provides*
- *The status of deployment of these systems at the urban fixed route systems*
- *The logical deployment sequence so that they build on each other ("best practices")*
- *Key interface requirements between elements to allow sequential deployment without sole source procurements.*

A table summarizing the status of deployment of technology systems at Illinois transit systems is shown in Table 1 in Section D. Technology elements are as follows:

### 1. *Schedule System*

For fixed route systems the foundation for all other technology is having routes, stops, and schedules available in a software based system. Having the data in a format consistent with the General Transit Data Feed Standard (GTFS) will ensure compatibility with other technology elements and between carriers. GTFS is an open (non-proprietary) standard composed of data elements for bus stops and routes that facilitates the transfer of information between systems within a transit agency as well as between agencies, and to agencies and companies that are focused on providing information to the public. The GTFS standard has spread rapidly around the world; there are well over a thousand agencies which have created GTFS for their systems. GTFS data can be submitted to U.S. DOT for the National Transit Map (http://gis.rita.dot.gov/Transit/), and submitted to Google for publishing in Google Maps. Stops will appear on Google Maps and Google Earth and trips can be planned using Google Maps.

The majority of the urban fixed route transit operators have data on their systems in GTFS "feeds". However, they vary considerably in the extent to which they have released/distributed the data; It appears that only three have made it readily available to the public or, more importantly, for app developers.

For small systems, existing schedule information can be converted to GTFS, using tools that are open source or available commercially, such as Trillium GTFS Manager. Most of the larger systems in the State have invested in a schedule system (i.e. Sched21, TransitMaster, Trapeze, Hastus, init, etc.) capable of building the schedule of trips for routes, bus blocks, and driver runs, based on local work rules. Having schedules in such a system makes it much easier to make adjustments to routes, trip times or running times. These systems provide data in GTFS format as a regular output.

The route network, the foundation of a fixed route system (and the core of GTFS data), is available for almost all urban transit agencies in Illinois in GIS. The coordinates of each stop (with separate records for stops in each direction) can be collected fairly expeditiously using a tablet and included in a stop database. Stop attributes such as the routes served (including other operators), presence of bus stop sign or shelters, timepoints, and paved pad/lighting at stop, etc. should be noted in a stop database. Transfer locations between routes, and between carriers, must be identified. Routes are typically defined as a sequence of stops. Garage pull-out/pull-in routes should also be defined.

Finally, it should be noted that analysis of demographic and other data is another valuable capability of technology. Several transit systems in the state have subscriptions to a system called Remix which combines GIS display of data with tools for rapidly developing routes and schedules and estimating ridership. Remix has recently started selling a version that integrates driver run cutting, making it a full-featured schedule software.

### 2. *Trip Planning*

Once the route/stop/schedule data is available in a GTFS feed, the information can be made available for developers of trip planning software which can be used by transit customers. The most commonly used trip planning is Google Maps (most of the Illinois urban transit operators have their data included). Since Amtrak routes and schedules are already included, long distance, inter-agency trips can be planned. If the data is posted online, third party developers of smartphone apps may include it in their trip planning as well. IDOT led the development of the Illinois Bus Network (www.illinoisbusnetwork.com) website, which includes a rudimentary trip planner. However, the data is several years
old and the site needs upgrading to meet current standards, as well as regular maintenance.

> Try it yourself. Go to Google Maps. Type in a starting address and then type in a destination. Madison County works well, since MCT's routes and schedules are in the system. You can always use the County Building as the destination.

### 3. *Computer-Aided Dispatch/Automatic Vehicle Location (CAD/AVL)*

CAD/AVL systems are used by transit operating agencies for real-time location and schedule adherence tracking. Several vendors are now able to cost-effectively provide GPS-based systems that are scaled appropriately for the downstate systems. The universal availability of cellular data service (usually with a choice of vendors) has made deployment of these systems much simpler. A key feature that CTA and Pace in northeastern Illinois have added to their CAD/AVL systems is the use of an onboard mobile router which provides communications which can be shared by multiple onboard systems, avoiding the need to install duplicative communication systems. New systems should adopt this architecture from the start.

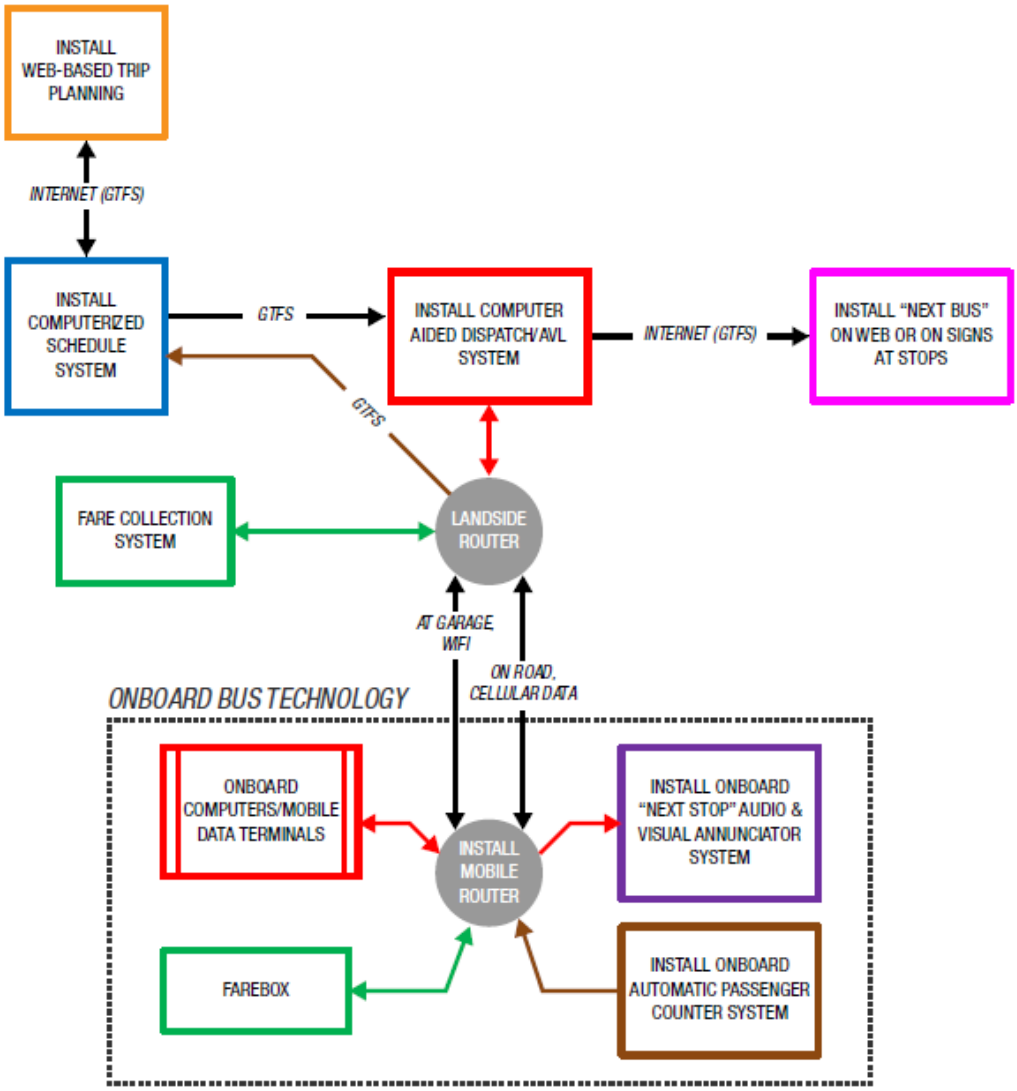


*Figure 1:* System Architecture

### 4. *Onboard "Next Stop" Audio and Visual Annunciator System*

"Next Stop" announcement systems help transit systems to meet ADA requirements, as well as adding convenience for all customers. Once a CAD/AVL system is in place, this is a relatively easy capability to add, with its onboard computer driving the sign and audio announcements. While these used to be sold as standalone systems, today they are most cost-effectively provided as an option by CAD/AVL system vendors.

### *5. Automatic Passenger Counter*

Automatic Passenger Counter (APC) systems allow detailed analysis of ridership, by trip, down to the route segment and even stop level of accuracy. While not 100% accurate, the data is easy to collect and makes planning much easier. Over time these systems have become more standardized and thus easier to deploy. Today these systems typically work with a CAD/AVL system which aggregates the data and transfers it to the agency network when the bus returns to the garage. These systems can be procured either separately or through the CAD/AVL system supplier. There are a small handful of vendors active in this specialty field.

### *6. "Next Bus" Information*

The feature that is probably most popular with passengers is the provision of real-time predicted arrival time information for buses at a specific stop. It is normally delivered over the internet (using either wired or wireless/cellular data). Smart phone access is very heavily used, but many signs have been installed by agencies at transit centers or bus stop/shelters. Some building owners, stores, etc. have installed signs for the convenience of their customers. CAD/AVL systems all now provide an output of this data in a format called "GTFS real-time". The data should be provided on a public-access server accessible to all app developers and those who want to install screens in their facilities.

### *7. Fare Collection*

A goal identified in the study is to move to modern systems that include stored value options to reduce cash handling requirements and provide convenience for passengers. Realistically, a related concern is that the basic cash fare in most downstate systems is $1.00. It is not going to be possible to hold at that convenient amount forever. Until recently it appeared that credit cards might be able to function as universal transit cards, as they are starting to in Europe (replacing transit agency cards). However, the U.S. standard adopted in conjunction with adding chips to credit cards did not include the second chip included on European cards which is optimized for rapid, small transactions. Thus, transit agencies wanting the benefits of smart cards will continue to be required to issue them. To date, the following Illinois transit systems have smart cards: CTA/Pace/Metra (Ventra), Connect (Bloomington-Normal), Danville, and the St. Louis area systems (including Madison and St. Clair Counties) which have the Gateway card in beta testing. However, the level of effort involved in each agency developing, marketing, distributing, and selling smart cards is a serious concern. The ability to expand the Chicago area Ventra card, or the St. Louis area Gateway card, to other parts of the state should be analyzed. The use of an onboard router may also facilitate the farebox sharing a Mobile Data Terminal (MDT) with a CAD/AVL system. There are a small handful of vendors active in the fare collection specialty field.

## *C. Rural Demand Response Systems*

Software that is appropriate for rural systems, which predominantly operate demand response service, provide dispatchers with status information (including location and schedule adherence), manage voice and data communications, and record statistics. For demand response systems the software is focused on taking rider requests, assigning them to trips, managing the performance of the service in real-time and keeping detailed records, including fares paid and creating any invoices. Many trip types require eligibility certification or are eligible for reimbursement by third parties (Medicaid, Medicare, or VA). Thus, the systems maintain client records and create invoices. The algorithms in computer-aided software are typically able to increase efficiency. The central system creates "manifests" which list all trips scheduled for each driver. Today, these are typically transmitted by cellular data to drivers using tablet computers. The tablets also provide turn-by-turn directions to drivers. It should be noted that many of the rural agencies primarily operate demand response service, but several of the systems operate significant amounts of flex route service and even fixed route service (usually, with no reservation requirement). A trend in the development of management systems for the rural operators is to move toward "cloud-based computing", i.e. with the server(s) housed remotely, with access via the internet. Thus, the transit agency is relieved of the responsibility for providing a person with the skills required for system maintenance, backups, and security. Today, even small towns typically have internet service of sufficient bandwidth and reliability for this approach to be feasible.

## *D. Existing Conditions: Technology Deployment in Illinois*

Both urban and rural systems have benefitted greatly from the advent of global positioning satellite (GPS) and cellular voice and data services which now allow services which remotely monitor vehicle location to work virtually anywhere in Illinois without the need to install and maintain expensive private radio services.

Among the 16 urban fixed route transit systems there is a wide variation in the degree to which technology systems have been deployed. At one end of the spectrum, CTA has deployed all of the systems described above (and Pace is in the process of deploying "next bus" signs and signal priority). Connect Transit (Bloomington-Normal) is at almost exactly the same point, including smart card fare payment, although it is not pursuing signal priority. St. Clair County Transit has a fairly complete deployment of technology, largely as a benefit of its operating contract with St. Louis Metro (including integrated fares). CUMTD (Champaign-Urbana) and MetroLink (Rock Island) are right behind, in that they do not yet have electronic fare collection (most CUMTD riders have prepaid farecards through the University of Illinois). Rockford, Springfield, Danville, Madison County and Go West (Macomb) are at various stages of implementing CAD/AVL systems. At the other end of the spectrum, Peoria, River Valley (Kankakee), Decatur, Quincy, and Galesburg (in descending order, by size) have not taken steps to implement technology systems.

| | Routes mapped in GIS? | Data in GTFS? | Schedule System? | All bus stops signed? | Trip planning in Google Maps? | Other trip planning? | Full CAD/AVL? | Interior "Next Stop" Annunciators? | "Next Bus" data on web? | "Next Bus" data on signs in terminal(s)? | "Next Bus" data on stops? | "Next Bus" data at Counters? | Automatic Passenger Collection? | Electronic Fare Collection? | Bus Signal Priority? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bloomington-Normal (Connect) | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | No |
| Champaign-Urbana (CUMTD) | Yes | Yes | Yes | Some | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | No | No |
| Chicago Transit Authority (CTA) | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Danville (DMT) | IP | IP | IP | Yes | IP | No | IP | No | No | IP | No | No | Yes | No | |
| Decatur (DPTS) | No | No | No | Yes | No | No | No | No | No | No | No | No | No | No | |
| Galesburg (GT) | Yes | No | No | No | No | No | No | No | No | No | No | No | No | No | |
| Kankakee (RVMTD) | Yes | Yes | No | Yes | Yes | No | No | No | No | No | No | No | No | No | |
| Macomb (Go West) | Yes | No | No | Yes | No | No | Yes | No | Yes | No | No | No | No | No | |
| Madison County (MCMTD) | Yes | Yes | Yes | Yes | Yes | No | IP | No | No | No | No | No | Yes | No | |
| Pace | Yes | Yes | Yes | 35% | Yes | Yes | Yes | Yes | Yes | IP | IP | Yes | Yes | IP | |
| Peoria (CityLink) | Yes | No | No | Some | No | No | No | No | No | No | No | No | No | No | |
| Quad Cities (MetroLink) | Yes | Yes | Yes | Some | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | No | |
| Quincy (QT) | No | No | No | 85% | No | No | No | No | No | No | No | No | No | No | |
| Rockford (RMTD) | Yes | Yes | Yes | Some | No | No | Yes | Yes | IP | IP | No | No | Yes | No | |
| Springfield (SMTD) | Yes | Yes | IP | Yes | Yes | No | IP | IP | IP | IP | IP | IP | No | No | |
| St. Clair County (Metro) | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | No | Yes | Yes | No | |
| Number installed, or in progress | 14 | 11 | 10 | 11 | 10 | 6 | 11 | 8 | 9 | 8 | 5 | 7 | 7 | 2 | |
| Percent installed, or in progress | 88% | 69% | 63% | 69% | 63% | 38% | 69% | 50% | 56% | 50% | 31% | 44% | 44% | 13% | |

IP In Progress (in procurement or under contract)

*Table 1:* Status of Deployment of Technology on Urban Fixed Route Transit Systems in Illinois

Exactly half (18 of 36) of the Illinois agencies which operate rural transit service have real-time management systems (as described above). Thus most of the operators that remain without computerized dispatch systems serve a single county.

## *E. Best Practices*

While in the past deployment of technology in transit was driven by operational needs, today there is an expectation among riders and the community as a whole that real-time information, will be instantly available by smart phone. Fortunately, with the shift to PC-based hardware (replacing Unix workstations), GTFS-based interfaces replacing proprietary ones, cloud-based servers able to replace local ones, and cellular data replacing private radio-based data, the tremendous dis-economies of small-scale deployments that used to exist have been greatly reduced. New companies, ready to quickly and cost-effectively deploy systems optimized for these new conditions have come into the marketplace. These changes are particularly relevant to the smaller transit agencies in downstate Illinois, both fixed route and demand response, who are now able procure computerized dispatch systems which will provide the public the information they want, when and where they want it, at lower cost, with less risk, and with faster deliver than in the past. Computerized management systems have now become "standard equipment" for both urban and rural systems.

# II. ACTION ITEMS

In order to implement transit technology for all agencies throughout the state, there are several action items that both IDOT and the transit providers can take. They are listed here:

1. IDOT should take a leadership role in the development, assembling, and deployment of GTFS data in the state, maintaining a registry of GTFS data feeds, as several other state governments have done. A key objective would be to ensure that trip planning works statewide. IDOT should get involved in the ongoing effort to develop a standard for integrating flexible route and demand response service. A major revamp of the Illinois Bus Network (www.illinoisbusnetwork.com) website, including its trip planner, should be included. A program for regular maintenance of whatever systems are established needs to be provided.
2. IDOT should consider buying a statewide subscription to the unique Remix transit planning tool, so that it would be available to all transit agencies in the state, both urban and rural. It may also be able to be used to create schedules (including output in GTFS format) for the smaller agencies.
3. IDOT should actively encourage transit agencies, both urban fixed route and rural, which have not yet installed computerized dispatch systems, to do so. This might involve some incentives and/or technical support. Especially given that the remaining agencies that don't have systems are the smaller ones, significant savings could be obtained through purchases which aggregate the remaining urban fixed route systems together and the remaining rural systems together.
4. Modernizing transit fare collection in the state by adopting a statewide smart card system should be investigated. This would increase customer convenience and reduce the need for agencies to handle cash. The best approach might be to add downstate systems to the Chicago area Ventra card or the St. Louis area Gateway card.