I. Scope of Services

A. *Overview*

The Chicago Transit Authority (CTA) operates the nation's second-largest public transportation system and covers the City of Chicago and 35 surrounding suburbs. CTA has 1,867 buses that operate 130 bus routes and serve more than 10,900 posted bus stops. In addition, CTA rail fleet numbers include 1,492 vehicles which operate over eight rail lines.

Accordingly, the CTA requires a robust and high-functioning transit scheduling system for bus and rail daily operations with the most up-to-date optimization tools. Such a scheduling system supports not only CTA's daily bus and rail service but interfaces with numerous other systems including daily operation and dispatch payroll, and trip planning functions.

The CTA Scheduling department is responsible for producing vehicle schedules, bus and rail operator (crew) schedules, and generating interfaces for the TOPS Trapeze system and other critical data systems. A robust software tool is needed to produce efficient and reliable schedules within budget constraints. The crew schedules must also comply with Collective Bargaining Agreement rules and assist in modeling new work rules.

A scheduling software tool is needed to optimize the daily schedules for over 4,000 bus operators who provide 18,000 bus trips per weekday. On the rail side of the business, daily schedules are created for over 1,300 rail operating personnel in five different classifications. The rail scheduling software must also incorporate CTA infrastructure constraints, including rail junctions, rail terminal and yard capacity. The volume and complexity of the CTA service requirements along with construction activities at CTA requires leading-edge information technology, strong maintenance support and a vendor committed to research and development of latest transit scheduling optimization tools.

The current scheduling software platform used by CTA is HASTUS version 2017, a product from GIRO, Inc. based in Montreal, Canada. The HASTUS system has been used in the day-to-day operations by the CTA Planning department for the development and maintenance of bus and rail operations schedules since 2001. CTA has made significant investment in customizations for scheduling practices and requirements in Hastus connected to our Collective Bargaining Agreement and bus and rail infrastructure.

This vendor recommends an upgrade every three to four years in order to take advantage of system enhancements and optimization improvements. Up to 30% of GIRO employees are engaged in research & development work; their scheduling technology is considered best-in-class. CTA currently operates a 2017 version of HASTUS and is due for an upgrade in 2022.

Therefore, CTA will undertake an upgrade from the current 2017 system to version 2022 to take advantage of new features. The timing/scheduling will be agreed upon at a later date, and after version 2022 has been in general release (operation) for some months. $535,000 for consulting days and travel is being contracted in anticipation of that upgrade.

B. *System Features*

- Vehicle scheduling software. The system must:
    - The ability to build and modify bus and rail trips, including undo/redo features.
    - The ability to shift trips to different vehicle blocks.

- Allow for graphical display of vehicle schedules and a vehicle accumulation feature
- Provides the capacity to enter and change route variants, time points, bus stop names and locations.
- Provides the capacity and flexibility to insert deadhead times and update deadhead mileage.
- The ability to set minimal layovers for vehicles by minutes or % of end-to-end run time.
- The ability to store multiple vehicle schedule scenarios.
- Have the functionality to couple and uncouple trains to adjust car lengths for rail scheduling.

- Crew scheduling. The system must:
  - Provide a robust platform for creating crew assignments pertaining for bus and rail personnel.
  - Allows efficient crew duties to be developed to cover vehicle blocks.
  - Provides automatic and interactive procedures to be able to cut vehicle blocks and combine pieces of work into valid duties.
  - Allow the ability to view two run-cutting solutions on a single screen.
  - Allow for automated methods to generate crew travel times for making reliefs.
  - Allows for crew assignment detail and display to be organized at the platform time, work time and pay time level.
  - Is programmed with rules that reflect CTA Collective Bargaining Agreements for bus and rail operators.
  - Allows soft rules to be modified to meet preferences of bus and rail operations.
  - Allow for expansion of new work locations and duty types.

- Vehicle and Crew optimization modules. The system must:
  - Produce automated solutions to minimize labor costs and fleet requirements while respecting CTA scheduling practices.
  - Include vehicle optimization tools to create vehicle blocks that minimize the number of vehicles used and minimize unproductive time
  - Deploy best-in-class technology for crew and vehicle scenario with the ability to modify or add new attributes for run cutting purposes.
  - Allow both crew and vehicle schedules to be viewed side-by-side.
  - Allow for multiple scenarios to be run simultaneously.

- Rostering. The system must:
  - Help prepare efficient weekly schedules for bus and rail operators.
  - Provide a scheduling tool for organizing work on a weekly basis.
  - Display relevant elements - duty numbers, work time and pay time by roster position.
  - Optimize weekly work using rule sets relating to efficiency, weekly hour caps, Collective Bargaining Agreement requirements, and day off requirements.

- Run time analysis. The system must:
  - Provide a run time analysis tool for both bus and rail based on allocation of travel time between timing points.
  - Provides for the ability to automatically import actual run time data to compare to scheduled run time.
  - Allows run time adjustments to be made based on percentages of actual run time.
  - Accommodate run time changes for 24-hour bus routes and rail lines.

- Rider measurement. The system must:
  - Import vehicle run times and ridership measurements from both bus and rail data.
  - Generate service planning options based on this data.
  - Allow for service planning options to be imported back into the scheduling platform.

- Report and interface requirements
  - Includes a summary report for peak fleet/vehicle requirements by location, day types and vehicle types or any other relevant attributes in the system.
  - Includes a summary report for manpower assignments based on location, day types and work and duty types.
  - The capability to generate lists and data summaries of schedule data.
  - The ability to conduct a database export or partial export.
  - The ability to run standard set of operator run paddles and supervisor guides for both bus and rail operations.
  - The ability to compress and store archival historical schedules.
  - The ability to generate timetables for bus and rail.
  - The ability to generate interfaces to other critical data systems identified by CTA.

- System architecture. The system must:
  - Provide for testing and deployment of new Hastus applications.
  - Allow for the easy creation of test and development instances.
  - Accommodate the download of an entire schedule database for transmission to the vendor for analysis purposes.

- System functionality. The system must:
  - Modify the upgraded software to include all previous customizations and change requests in current version of the software, unless specified by CTA.
  - Include modules: Vehicle, Crew, Crew Opt, MinBus/MinRail, Roster, HASTOP, ATP and Rider
  - Offer functionality and features within the above modules which is equal to or enhanced to the current system software vendor
  - Include all the interfaces currently generated via Hastus 2010, unless noted by CTA.

C. *Customer Service and Maintenance Support*

Customer support as provided by GIRO's CTA project manager or back-up is required during the agency's regular business hours 08:00-16:30 (Central Time). During these hours, access to help desk resources is also a must and will be especially helpful to CTA Scheduling's technical inquires. This contact will be via e-mail and or phone.

The vendor must offer a maintenance and support contract. CTA is open to a two-tiered approach where a baseline service: a) provides technical support, trouble-shooting and analysis for **day-to-day** use of the system and b) corrects defects in the software. For **more complex projects**, CTA prefers an agreement where the agency can draw from a bank-of- hours support purchased in advance. In regard to contract detail, CTA is also open to an arrangement in which a multi-year maintenance support contract is purchased along with the application upgrade.

D. *Upgrade Work and Services*

CTA Note: An upgrade to version 2022 is targeted, and will be execute in late 2022 or in 2023. The proposed work and services must include the following elements:

1. Project management
   a. Organize and supervise the vendor's project team.
   b. Prepare status reports as required
2. Review and validation of system specifications
3. Preparation of database conversion scripts to convert the database from version 2017 to version 2022. These scripts will be run by CTA personnel to upgrade the version in CTA's environment
4. Configuration to initialize relevant variables, set parameters and make system adjustments
5. Migration of customized software to the new version. This involves vendor inspection of relevant customizations and application features.
6. Algorithm recalibration which involves review of the HASTUS cost functions rules and parameters. Also, calibrating the algorithms ensures that automatic solutions continue to meet on-going CTA requirements
7. Testing prior to delivery of all customized features using a representative set of CTA dat.
8. Customizations (count) created as a result of GIRO's Gap Analysis visit date to be determined at a later moment).
9. Provide hands-on training to CTA Scheduling and Service Planning staff on the new features of Hastus 2022.
10. Provide implementation support answering functional questions and advising users on how to use the application effectively for CTA's scheduling needs.
11. Create / Recreate the role based security defined in the current Hastus release.

System Architecture
GIRO will provide Hastus 2022 network and server infrastructure design document using the CTA Architecture document template. The architecture document should include all required software, hardware and 3rd party software needed for proper execution and maintenance of the Hastus 2016 software. The design environment should include all configurations needed to correctly build the– Test environment, Production environment with dynamic failover with high availability configuration and offsite manual disaster recovery onto a mirrored site.

The system design should meet the minimum need of supporting 35 super users logged in at any given time with the ability to expand for up to 60 users. The system and its architecture should support a peak of 35 batch jobs run in parallel by both bus and rail scheduling super users. The architecture design should support dynamic failover and disaster recovery to a secondary CTA data center. GIRO will assist CTA in defining, configuring and establishing the infrastructure and failover / DR mechanism for the system. The system architecture should include a 99.9% uptime and be utilized 24/7 365 days a year. CTA requires that all upgraded environment be supported at a minimum under Window 2012. The windows servers should be virtual servers running under vSphere 5.x or later version. These virtual servers should also be supported under Microsoft Hyper-V in order to provide CTA with future flexibility. The system should support Oracle as RDBM database preferably running on AIX.

CTA will procure and built the server / network infrastructure based on the approved Architecture document as agreed by both parties. CTA will install the operating system, database RDBMS software and GIRO will install the Hastus application.

Project Management
GIRO will assign a project manager to ensure all work required to organize, supervise , plan, execute, control and deploy the Hastus 2022 system are executed efficiently and in line with the agreed project

plan. The project plan should at minimum include agreed end user requirements , business needs, customizations approved, project schedule, project milestones and associated cost management, quality management plans, communication plan and contract management plans. The project manager will own all project management activities in accordance to industry PMO practices and CTA IT PMO procedures. The project manager will ensure that all milestone deliverables are quantity controlled and approved by all parties. GIRO is expected to use the tools and technologies that are aligned with CTA tools [Office 2010; SharePoint 2010, Visio 2010, Microsoft project 2010]. CTA prefers GIRO to use online SharePoint tool hosted by CTA to store project documents and records – issue, risk, decision log, change log etc. The project manager shall lead weekly status meetings, provide weekly status reports, ensure project issues / risks/ decisions are assigned / tracked to closure.

Quality Assurance:
GIRO should ensure quality control and assurance ("QA") is built into each milestone delivery. The QA procedure should be agreed by both parties and be included as part of master project plan. GIRO should at minimum provide documented factory test cases / expected results / actual results, to cover all CTA customized scenario testing, enterprise interfaces and required data conversion testing. CTA server infrastructure and network infrastructure along with automated performance testing should be included in the factory test cases. GIRO should provide CTA business leads with User-acceptance test ("UAT") case scenarios and ensure all errors recorded during the UAT phase are implemented.

End User Training:
The Contractor is required to provide in person training at CTA's Headquarters at 567 W Lake St, Chicago. The Contractor is required to conduct separate training session for super-users and end-users as outlined below. In addition:

a.   The Contractor will develop training materials. The Contractor will send draft training materials to CTA six weeks before the training begins.
b.   Agendas and materials must be approved by CTA for each module before training begins and shall include:
    I.   Instructor Guides
    II.   Student Workbooks which include:
      i.   Screen shots to accompany system walk through
      ii.   Hands on activities
c. Training shall be delivered end user format for the following user groups:
    I. System Administrator and Super Users Scheduling Managers and Coordinators)
    II. End-users of Hastus Scheduling (Scheduling Analysts, Managers and Coordinators)

The training must be provided in two phases. The first phase of the training will include all super users and system administrators and will conclude before the start of user-acceptance (UAT) testing. Phase two will include all staff in the Scheduling department (14 total) and will take place after delivery of the customized and configured software. The end-user will cover the new features of the software since the last upgrade. Both phases of training must be completed before project deployment.

On-site Services:
GIRO should be available at CTA facility during the project requirements collection phase, system design & configuration review phase, hardware & infrastructure design phase, database conversion / deployment launch and at other times as deemed essential during the project execution. The visits will occur on a mutually agreed upon dates.

APPENDIX A – additional customizations

NOTE: Additional customization modules to be clarified after a renewed GAP Analysis at a later date, preceding start of upgrade.	NOTE: Additional customization modules to be clarified after a renewed GAP Analysis at a later date, preceding start of upgrade.
Public Timetable interface (Specs 5.9.2)	Public Timetable interface enhancement: - For Bus and Rail: Include the headway in the interface. - For Rail: Generate the interface for all places, not only timing points. Attributes "Trp start headway" and "Trp end headway" can be added via configuration. CTA to confirm if this meets the requirement. To generate the interface for all places, all places including those that are not timing points must be listed in the place pattern.
Roster report (Specs 5.9.6, 5.9.6.1, 5.9.6.2)	Roster report: Terminology adjustment to the title The following customization will be made: - Add the option to change the report title to "Work week report
Bus Supervisor Guide (Specs 5.10.1.1)	The report to be based on the customized Headway Report. The aim is to increase the font size to 10 pts and use all rows on the page, down to a one-row buffer at the bottom of the page. Shade every other line. A line can be multiple if OX Final design will be determined in the Specifications phase. The following adjustments are under consideration: Merge the "From Garage" and the "Leave place" columns. Merge the "To Garage" and the "To Place" columns. Transfer the DH note for fall back (Deadhead to intermediate place) to a timing point note on the last TP of the preceding trip. Eliminate the "To Gar" and "From Gar" columns.
Rail Supervisor Guide (Specs 5.10.1.2)	Crystal Reports adjustments as follows. Adjust the direction of the relief before the duty that covers the trip. Requires a UD field for Clockwise and Counterclockwise route. Display the timing point note after the timing

	point passing time. Shrink the text note box to minimum size. Added Reliefs to be underlined instead of having the "carrot" symbol, and add the relief note description in the note box. When a trip does not operate every day of the week, add the text "Trip operates on <operating days>". This text will appear after or before the trip's passing times if there is sufficient space. If not, then it will be printed on a second line. Crew-in not always printed correctly (bug covered by the maintenance contract). Crew Next Leave not always printed correctly (bug covered by the maintenance contract).
Run Paddle (Specs 5.10.3)	Keep Leader/Follower: Maintain Leader/Follower calculation. For 2-piece part-time duties, second reporting time (*SignOn*) to be printed in the header. This requires a line addition in the left-hand side header and printing the half-duty start times instead of the report time. Note: CTA understands that incorrect Leader/Follower information would be displayed during periods where there are day-type transitions: Weekday-Saturday, Saturday-Sunday, Sunday-Weekday
Rail Paddle (Specs 5.10.4)	Rail Paddle to display "Relieved by" with the duty number if relief type is Street relief. The following customization will be made: - Adjust pce_start_rail and pce_end_rail attributes to consider any route and any place. - Adjust pce_start_disp and pce_end_disp to ignore unattended street reliefs. - Adjust the report, block blcRelPceStart3c to generate relief information similar to the block blcRelPceEnd3c: "Relieve 501 13:52 at Howard Sta. Nb". - Drop the R in duty number when there is a relief.
Bus Run guide (Duty list) (Specs 5.10.12)	The Bus Run guide (Duty list) is posted in support of the work pick process. The following customization will be made: - Display second report time on the header line. - Replace the attribute dty_time_start0 by and equivalent half-duty attribute.
WTT & WTT Both Directions	The following customization will be made: Set default flag Show headway so it is always set whenever a schedule is accessed. - Investigate if it will be possible to toggle; otherwise it is acceptable to keep the field output. - There is no requirement to save the setting since it will always be set to TRUE. - Requires some testing to confirm the final setup.

Vsc08 – Vehicle statistics for Rail	Addition of Car miles statistics. GIRO suggests enabling the *HASTUS* Rail sub-system in CTA's *HASTUS* version 2016 and defining a second *HASTUS* icon to be used in the rail context. The Rail sub-system will provide access to windows specifically designed for Rail that replaced existing windows designed for Bus. This applies to Vsc08 which provides vehicle statistics and unit statistics With the Rail sub-system.