

**Memorandum of Understanding No. MOU-2022-1-ACORN**

**Original Memorandum of Understanding**

**between the**

**Connecticut Department of Transportation**

**and the**

**University of Connecticut**

**for**

**“Operation and Maintenance of a Real-Time Network**

**Positioning System for Connecticut Department of**

**Transportation - Advanced Continuously Operating Reference**

**Network (ACORN)”**

This Memorandum of Understanding (hereinafter referred to as “MOU”), by and between the Connecticut Department of Transportation (hereinafter referred to as “CTDOT”) and the University of Connecticut (hereinafter referred to as “UCONN”), provides a broad range of services and primarily focuses on its mission to provide a safe, efficient and cost-effective transportation system that meets the mobility needs, and is aimed at improving the lives, of Connecticut’s people. Similarly, UCONN serves the people of Connecticut through the teaching, research and public service activities carried out on its campuses. Through various joint activities, both CTDOT and UCONN can accomplish their respective missions in some areas of specialization.

For purposes of this MOU, cooperative projects are defined as any activity of interest where joint participation between CTDOT and UCONN will improve the capacity of CTDOT to provide enhanced services to the people of the State of Connecticut and will develop the ability of UCONN to further its teaching, research and public service missions.

Acknowledging the commonality of interests involved, CTDOT and UCONN enjoy mutual benefits by entering into a cooperative working association with each other under terms that will aim towards achieving their respective missions and, thus, maximize the benefits for both resulting from the unification of purpose and sharing of resources.

**WITNESSETH, THAT:**

**WHEREAS**, CTDOT provides a broad range of services and primarily focuses on its mission to provide a safe, efficient and cost-effective transportation system that meets the mobility needs of the people; and,

**WHEREAS**, UCONN, acting through its respective campuses, provides teaching, research and public services for the people of Connecticut; and,

**WHEREAS**, both parties agree that the people are best served when the resources and expertise of its public entities are shared to address topics of common interest; and,

**WHEREAS**, UCONN is authorized to enter into this MOU under Sections 10a-104, 10a-108 and 10a-110 to 10-110g of the General Statutes of Connecticut as amended to date; and,

**WHEREAS**, CTDOT is authorized to enter into this MOU under Sections 13b-4, 13b-10 and 13b-23 of the General Statutes of Connecticut, as amended to date; and,

**NOW, THEREFORE, KNOW YE THAT:**

CTDOT and UCONN enter into this MOU (MOU No. MOU-2022-1-ACORN) to conduct a research study entitled, "Operation and Maintenance of a Real-Time Network Positioning System for Connecticut Department of Transportation - Advanced Continuously Operating Reference Network (ACORN)," under the terms and conditions specified below. These terms and conditions remain in full force and effect, until amended or terminated.

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## Section I.MOU Sections

### 1. TERM

The term of this MOU shall begin on January 1, 2022 and shall expire on June 30, 2022.

### 2. PROJECT IDENTIFICATION AND PROPOSAL

The work to be carried out during the period of this MOU is described in the proposal (hereinafter referred to as "Proposal") for the project identified below. The Proposal is attached hereto and incorporated as part of this MOU.

CTDOT Project MOU

NETC Project MOU

Project Title: "Operation and Maintenance of ACORN"

Research Study Title: " Operation and Maintenance of a Real-Time Network Positioning System for Connecticut Department of Transportation - Advanced Continuously Operating Reference Network (ACORN)"

### 3. PROJECT FUNDING

Funds, facilities, assigned personnel or other contributions made by either party shall be available only for the work described in this MOU.

Neither CTDOT nor UCONN is obligated to expend funds or to make payments in excess of the amounts specified in this MOU and any relevant Amendments.

For multiple-year projects, future participation may be contingent upon legislative or congressional appropriations to CTDOT and/or UCONN.

This project is being funded 100% from CTDOT's Operating Expense Account.

The total project cost for the period of this MOU shall not exceed \$132,468.

State Funds:           \$ 132,468

Other Funds:       \$ -

Total Funds:         \$ 132,468

#### **4. PRINCIPAL INVESTIGATOR(S)**

(A) UCONN shall assign the Principal Investigator(s) for each project conducted under this MOU.

(B) The Principal Investigator(s) or, in his/her/their absence, his/her/their supervisor shall provide technical leadership and conduct the activities of the project, including all progress reports, technical reports, and other project deliverables.

The following individual(s) are designated as Principal Investigator(s):

Name: Dr. Thomas H. Meyer

Title: Professor of Geodesy

Organization: University of Connecticut

Address: Department of Natural Resources and the Environment

WB Young Building, Room 308b

1376 Storrs Road, Unit 4087

Storrs, CT 06269-4087

Telephone: (860) 486-0145

E-Mail: [Thomas.Meyer@UCONN.edu](mailto:Thomas.Meyer@UCONN.edu)

#### **5. PROJECT ADMINISTRATORS**

(A) The Project Administrator(s) shall be the contact person(s) for the business aspects of this MOU, including all invoices, payments and Project Amendments.

(B) All related correspondence shall be directed to the Project Administrator(s) so designated in this MOU.

The following individuals are designated as Project Administrators to serve as contacts for business matters:

**CONNECTICUT DEPARTMENT OF TRANSPORTATION**

Name: Mr. James Fallon  
Title: Assistant Chief Engineer  
Organization: Connecticut Department of Transportation  
Address: 2800 Berlin Turnpike, P. O. Box 317546  
Newington, CT 06131-7546  
Telephone: (860) 594-2975  
E-Mail: [James.Fallon@ct.gov](mailto:James.Fallon@ct.gov)

**UNIVERSITY OF CONNECTICUT**

Contractual Matters:

Name: Mr. Mark Reeves  
Title: Director, Sponsored Program Services  
Organization: University of Connecticut  
Address: Sponsored Program Services  
438 Whitney Road Extension, Unit 1133  
Storrs, CT 06269-1133  
E-Mail: [spscontracts@uconn.edu](mailto:spscontracts@uconn.edu)

Fiscal Matters:

Name: Ms. Angela Garvin  
Title: Manager, Financial Services  
Organization: University of Connecticut  
Address: Sponsored Program Services  
438 Whitney Road Extension, Unit 1133  
Storrs, CT 06269-1133

E-Mail: [angela.garvin@uconn.edu](mailto:angela.garvin@uconn.edu)

Post-Award Administration:

Name: Mr. Matthew Cahill  
Title: Post Award Team Leader  
Organization: University of Connecticut  
Address: Sponsored Program Services  
438 Whitney Road Extension, Unit 1133  
Storrs, CT 06269-1133  
Telephone: (860) 486-3864  
E-Mail: [matthew.cahill@uconn.edu](mailto:matthew.cahill@uconn.edu)

**6. PROGRESS REPORT(S)**

UConn will provide progress report(s), if specified in the Proposal, on a(n) quarterly basis, in accordance with the provisions specified below:

UConn will provide CTDOT with progress reports in electronic Microsoft Word Format documents, which are to be received by the last day of the end of the reporting period.

**7. INTERIM REPORT(S)**

UConn will provide interim report(s), if specified in the Proposal, in accordance with the provisions specified below:

UConn will provide CTDOT with a draft interim report(s) in electronic Microsoft Word and ADOBE™ Portable Document Format (PDF) document(s), on specified tasks for review by CTDOT and the Federal Highway Administration (FHWA). Within ninety (90) calendar days after acceptance of the interim report(s) by CTDOT, subject to action on review commentary, six (6) copies of the interim report(s) shall be furnished to CTDOT. A set of reproducibles, as well as an electronic ADOBE™ Portable Document Format (PDF) document, used in



the preparation of the interim report(s), will be provided to CTDOT within thirty (30) calendar days after the interim report(s) is(are) delivered to CTDOT.

The draft interim report(s) and the interim report(s) shall be Section 508 Compliant, as stated in 36 CFR 1194.

## **8. FINAL REPORT(S)**

UCONN will provide a final report(s), if specified in the Proposal, in accordance with the provisions specified below:

UCONN will provide CTDOT with a draft final report(s) in electronic Microsoft Word and ADOBE™ Portable Document Format (PDF) document(s) for review by CTDOT and the Federal Highway Administration (FHWA). Within ninety (90) calendar days after acceptance of the final report(s) by CTDOT, subject to action on review commentary, six (6) copies of the final report(s) shall be furnished to CTDOT. A set of reproducibles, as well as an electronic ADOBE™ Portable Document Format (PDF) document, used in the preparation of the final report(s), will be provided to CTDOT within thirty (30) calendar days after the final report(s) is(are) delivered to CTDOT.

The draft final report(s) and the final report(s) shall be Section 508 Compliant, as stated in 36 CFR 1194.

## **9. INDEPENDENT CAPACITY**

- (A) The parties agree that employees of CTDOT, in the performance of their duties and activities under this MOU, shall continue to be in the legal status of CTDOT employees and not as employees of UCONN.
- (B) Likewise, employees of UCONN, in the performance of their duties and activities under this MOU, shall continue to be in the legal status of UCONN employees and not employees of CTDOT.

## **10. CHANGES IN THE PROPOSAL**

- (A) The scope of work, budget, period of performance, specification of deliverables, or any other part of this MOU shall be amended by mutual agreement of the parties to this MOU.
- (B) This MOU need be formally amended only for significant project changes as defined in Section 10(A) above, an increase or decrease in the amount of funding, an extension to the project or early termination of the project.
- (C) Refer to Section 12 regarding provisions for changes in the approved budget.

## **11. Project Costs**

Project costs shall include all necessary costs for the work conducted under this MOU, in accordance with the approved budget. Project costs may include, but are not limited to, the following:

- (A) Compensation for all personnel directly engaged in the performance of work conducted under this MOU, including reimbursement to other employers for the services of borrowed personnel.
- (B) Fringe benefits shall be charged at rates that are in effect at the time of execution of this MOU, as established by the State of Connecticut, Office of the State Comptroller, and by UCONN.
- (C) Reimbursements for travel costs or similar expenses shall be governed by the relevant collective bargaining Agreements in effect between CTDOT or UCONN and its employees, and/or applicable State of Connecticut, CTDOT or UCONN policy.
- (D) Any other necessary direct costs and expenses incurred in the conduct of the work under this MOU.

## **12. CHANGES IN BUDGET**

In the event that a transfer of funds between budget categories contained in the approved budget is required, UCONN may make cumulative transfers among direct cost categories of up to 10 percent (10%) of the total approved budget without approval of CTDOT. Larger changes require prior approval by CTDOT. In no case, however, will CTDOT be responsible for expenses in excess of the approved total amount.

## **13. INVOICES AND PAYMENTS**

- (A) UCONN shall submit properly executed invoices (State Transfer Invoice), no later than forty-five (45) calendar days after the end of each billing period, for payment for a billing period not to exceed a calendar quarter. The invoice shall indicate the total costs incurred for the billing period in accordance with the provisions of Section 13 (C) below.

The State Transfer Invoice shall be submitted to:

Name: Mr. James Fallon  
Title: Assistant Chief Engineer  
Organization: Connecticut Department of Transportation

Address: 2800 Berlin Turnpike, P. O. Box 317546  
Newington, CT 06131-7546

E-Mail: [James.Fallon@ct.gov](mailto:James.Fallon@ct.gov)

Payments to UCONN for work specified shall be based upon the following dated and signed certification: "The undersigned hereby certifies that payment of the sum claimed under the cited MOU is proper and due and that information on the fiscal report is correct and such detailed supporting information is on file, available for certification and/or audit purposes, and that all services called for by the MOU to the date of this billing, \_\_\_\_\_, have been met.

_____	_____
Director or Appropriate Title	Date

- (B) CTDOT shall pay UCONN, in accordance with the approved Proposal, for all work authorized by CTDOT and performed in accordance with the terms specified herein. UCONN may request partial payments for work performed. These requests for payment may be submitted for a billing period not to exceed a calendar quarter. Partial payment will be made by CTDOT on the following basis:
- (1) Partial payments will be equal to 100 percent (100%) of UCONN's costs incurred for each billing period, in conformance with the budget contained in the Proposal, until the cumulative total amount invoiced equals 95 percent (95%) of the total of this MOU value. If an invoice is submitted which results in the cumulative total amount invoiced exceeding 95 percent (95%) of the total MOU value, CTDOT shall withhold payment of that invoice and any further invoices, in accordance with the provisions of Section 13(C)(3).
  - (2) CTDOT agrees to pay UCONN an amount not to exceed the total amount of the approved budget contained in the Proposal, for the contract period, established in accordance with the provisions of Section 3(C).
  - (3) Final payment will be processed following completion of all services called for in this MOU, as well as receipt of all project deliverables. The final payment to UCONN shall include the amount invoiced for the final billing period, plus any amount withheld on previous billings, in accordance with the provisions of Section 13(C)(1).

**14) FISCAL RECORDS**

- (A) UCONN will maintain an accounting system that is adequate to segregate and accumulate reasonable, allocable and allowable costs and maintain accounts and

records in accordance with generally accepted accounting principles consistently applied.

- (B) All books, documents, payrolls, papers, accounting records and other evidence pertaining to costs incurred under this MOU shall be maintained, and such records shall be made available during regular working hours for inspection by authorized representatives, during the period of this MOU and for three years thereafter.
- (C) These records shall reflect total project costs, including documentation of CTDOT and UCONN contributions and all third-party contributions, to the project. Copies of project records shall be furnished, if requested.
- (D) UCONN shall preserve all of its records and accounts concerning the implementation of this MOU including, but not limited to, any records, books, or other documents relative to charges, including charges for extra work, alleged breaches of the Project Agreement, settlement of claims, or any other matter involving UCONN's or Subcontractor's demand for compensation by CTDOT for a period of not less than three (3) years from the date of the termination of this project under this MOU. If any litigation, claim, or audit is started before the expiration on the three (3) year period, the records shall be retained until all litigations, claims, or audit findings involving the records have been resolved.
- (E) UCONN shall permit the authorized representatives of CTDOT, the United States Department of Transportation and the Comptroller General of the United States to perform an annual inspection and audit of all data and records of UCONN relating to its performance under this MOU.

#### **15) SUBCONTRACTS**

UCONN shall obtain written approval from CTDOT before entering into any subcontract with other party/parties to perform all or a part of the approved Proposal.

#### **16) SUBLETTING, ASSIGNMENT or TRANSFER**

Neither party shall sublet, sell, transfer, assign or otherwise dispose of its right title or interest in this MOU, or any part thereof, without the written consent of the other party.

**17) OWNERSHIP(A)** The title to all products of research generated under this MOU shall be determined according to United States patent law or copyright law, as applicable. UCONN may use any of the data, plans and reports completed under the terms of this MOU for whatever purpose and may distribute products in any way. However, the following text must appear on the inside front of any reports or publications:

“This report was prepared by the University of Connecticut, in cooperation with the Connecticut Department of Transportation and the United States Department of Transportation, Federal Highway Administration. The opinions, findings and conclusions expressed in the publication are those of the author(s) and not necessarily those of the Connecticut Department of Transportation or the Federal Highway Administration. This publication is based upon publicly supported research and is copyrighted. It may be reproduced in part or in full, but it is requested that there be customary crediting of the source.”

(A) (B) Capital Equipment Ownership Listing

Capital equipment is defined to include tangible, nonexpendable, personal property charged directly to this MOU, and as defined by applicable federal and state legislation in effect at the start of this MOU.

Title to all capital equipment purchased by UCONN with funding under this MOU shall remain the property of CTDOT upon completion or termination of this MOU, subject to applicable FHWA regulations.

(C) UCONN shall maintain a list of all equipment procured under this MOU, and priority for use of such equipment throughout its useful life shall be to further the joint cooperative ventures of the parties.

**18) INTELLECTUAL PROPERTY**

(A) The terms "Invention" or "Discovery," as used herein mean any invention or discovery of UCONN conceived or first actually reduced to practice in the course of or under this MOU, and includes any art, method, process, machine or manufacture, design or composition thereof, or any variety of plant, which is or may be patentable under the Patent Laws of the United States of America or any foreign country. With respect to any Invention or Discoveries resulting from the Work under this MOU, the parties agree that the requirements of applicable federal regulations shall apply and control and, in case of a conflict with a provision of this MOU, shall supersede and control.

(B) Each party shall promptly disclose to the other party any potentially patentable Inventions or Discoveries resulting from the products of research or work product of the parties under this MOU, which obligation shall survive the expiration of the term, or earlier termination, of this MOU. UCONN's periodic reporting requirements defined in this MOU shall include disclosure of potentially patentable inventions or discoveries first conceived or reduced to practice since the prior report. Inventions made during the performance of the work solely by inventors or authors who are UCONN employees will be owned by UCONN ("UCONN IP"). Inventions made during the performance of the work solely by inventors or authors who are CTDOT's employees will be owned by

CTDOT (“CTDOT IP”). Inventions made during the performance of the work jointly by inventors who are UCONN’s employees and CTDOT’s employees will be owned jointly by UCONN and CTDOT (“Joint IP”). Upon such disclosure of any Inventions or Discoveries, whether or not patentable, the parties must agree in writing upon their respective rights and obligations with respect thereto, and the terms and conditions thereof, prior to the filing of any patent application, licensing of rights to, sale, transfer, or other commercial exploitation of the Invention or Discovery, all in accordance with the applicable federal regulations. The parties will memorialize their agreement by the exchange of mutual written consent(s) signed by an authorized representative of each party.

## **19) PUBLICATION RIGHTS**

### **(A) Copyright Provision**

Provided not in conflict with any FHWA requirements with respect to SPR funding or other applicable federal requirements, either party shall be free to file a federal copyright registration for original works of authorship it creates, and the parties together may pursue jointly a federal copyright registration for works of authorship jointly created, under this MOU, and shall reserve to the other party and FHWA a royalty-free, non-exclusive and irrevocable license to reproduce, publish, or otherwise use, and to authorize others to use the work for government purposes, all in accordance with any applicable federal grant requirements.

### **(B) Publication Disclaimer Statement**

No reports, articles, papers or publications may be published by UCONN without the written authority of CTDOT except as provided for in the following items:

All reports, articles, papers or publications shall contain the disclaimer: “This report [article, paper or publication] does not constitute a standard, specification or regulation. The contents of this report [article, paper or publication] reflect the views of the author(s) who is(are) responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the views of the Connecticut Department of Transportation or the Federal Highway Administration.”

## **20) GOVERNMENTAL REQUIREMENTS**

(A) This MOU uses Federal funds in accordance with 2 CFR § 200.

- (B) The parties agree to comply with all Federal and State of Connecticut ordinances, laws, regulations and policies, as applicable to their respective organizations, including, but not limited to, by reference: 2 CFR § 200 addressing federal procurement procedures; applicable Public Acts addressing Equal Employment Opportunity and Non Discrimination; Executive Orders delineated in Connecticut Governor Dannel P. Malloy's Executive Order No. 47, dated April 24, 2015, and those Executive Orders amended or enacted in the future; the Regulations of the United States Department of Transportation (Title 49, Code of Federal Regulations, Part 21), issued in implementation of Title VI of the Civil Rights Act of 1964, 78 Stat. 252, 42 U.S.C. 2000d to 2000d-4; and, Appendix CR.
- (C) UCONN agrees to comply with 2 CFR § 200.317 addressing federal procurement procedures. UCONN further agrees to provide UCONN's procurement procedures that will be used under this MOU to FHWA for approval.

## **21) TERMINATION OF MOU**

- (A) This MOU may be terminated in its entirety by either party upon sixty (60) days' written notice to the other party. This MOU may be terminated by CTDOT at any time if UCONN fails to comply with all Federal and State of Connecticut ordinances, laws, regulations and policies, as applicable to their respective organizations, or fails to perform in accordance with the terms and conditions set forth in this MOU. UCONN will immediately act to minimize project costs upon issuing or receiving such notice, and will submit to CTDOT a report describing all work completed to date.
- (B) This Agreement may be terminated by either party on at least sixty days (60) days advance written notice to the other party specifying the date of termination.
- (C) CTDOT will reimburse UCONN a percentage of the total project cost that is equal to the percentage of work completed.
- (D) Upon receipt of written notification from either party that this MOU is to be terminated, UCONN shall immediately cease operations on work stipulated in this MOU and assemble all material that has been prepared, developed, furnished or obtained under the terms of this MOU, that may be in its possession or custody and shall transmit the

same to CTDOT on or before the sixtieth (60<sup>th</sup>) day following the receipt of the written notice of termination. Said material shall include, but not be limited to, documents, plans, computations, drawings, notes, records, correspondence, and other deliverables.

- (E) In the event of termination of this MOU, UCONN shall permit the authorized representatives of CTDOT, the United States Department of Transportation, the Federal Highway Administration and the Office of the Inspector General to inspect and audit all data and records of UCONN relating to its performance under this MOU until the expiration of three (3) years after termination of this project under this MOU.

UCONN further agrees to include in all its subcontracts here under a provision to the effect that the subcontractor agrees that CTDOT, the United States Department of Transportation, the Federal Highway Administration and the Office of the Inspector General, or any of their duly authorized representatives, shall until the expiration of three (3) years after termination of the project under the subcontract, have access to and the right to examine any directly pertinent books, documents, papers, and records of such subcontractor, involving transactions related to the subcontract.

## **22) APPROVALS**

This MOU is subject to the approval of:

For CTDOT: the Commissioner, or his/her designee.

For UCONN: the President, or his/her designee.

## **Section II. Signatory Sheet**



## Section II. Signatory Sheet

FOR MEMORANDUM OF UNDERSTANDING NO. MOU-2022-1-ACORN

CONNECTICUT DEPARTMENT

OF TRANSPORTATION

APPROVED DATE: \_\_\_\_\_

BY: \_\_\_\_\_

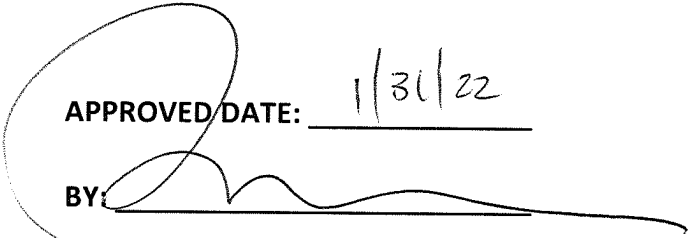
Authorized Signature

Name: Mr. James Fallon

Title: Assistant Chief Engineer

UNIVERSITY OF CONNECTICUT

APPROVED DATE: 1/31/22

BY: 

Authorized Signature

Name: Mr. Mark Reeves

Title: Director, Sponsored Program  
Contract Services

# **Transportation - Advanced Continuously Operating Reference Network (ACORN),”**

Proposal No. MOU-2022-1-ACORN

Prepared by

Thomas H. Meyer, Ph.D.

Professor of Geodesy, Department of Natural Resources and the Environment University of

Connecticut

## **Section III. Operation and Maintenance of a Real-Time Network Positioning System for Connecticut**

## A. Problem Description and Background

CTDOT has evolved its existing Continuously Operating Reference Stations (CORS) from only serving static data to also serving streaming real-time messages that allow roving Global Navigation Satellite System (GNSS) receivers, such as the U.S. NAVSTAR Global Positioning System (GPS), to determine centimeter-accuracy positions in real time. This capability:

- 1) provides support to CTDOT personnel for inspection purposes and contractors using Automated Machine Guidance (AMG), and
- 2) supports CTDOT Survey Operations and other positioning-dependent CTDOT engineering activities.

As an ancillary benefit, the service is available at no charge to Connecticut residents, including land surveyors and mappers. This network was developed under MOU-S2253-5-2015-10 and its amendments.

UCONN operates nine Trimble GPS base station receivers for CTDOT, which form the Advanced Continuously Operating Reference Network (ACORN). ACORN also utilizes four additional base stations, one in New York, two in Massachusetts, and one in Rhode Island to supplement the nine stations located in Connecticut. GNSS data are used kinematically to allow centimeter-accuracy positioning in real time (Real-Time Kinematic (RTK) positioning). Although RTK positions are generally less accurate than static positions, RTK can achieve accuracies sufficient for topographic land surveys, verification, and for quality assurance checking of as-built works. RTK presents a substantial efficiency bonus over other positioning technologies for these purposes.

GNSS real-time positioning requires that a stationary receiver, called a “base,” be operated at a reference location. The base observes all satellites in view and broadcasts those observables to roving GNSS receivers (called “rovers”) that are conducting fieldwork. With RTK, the base communicates to the rovers either by FM radio or over the Internet via cell phones. When the base is erected in the field, then someone must supervise it during the day, effectively tying up that person to “baby-sit” the station instead of performing more valuable tasks. If the base is erected on a passive control marker, like a brass cap, then setup-error propagates directly into the error budget of the rovers, as does any inaccuracy of the marker’s coordinates. If the base communicates using a FM radio, it might need to be moved throughout the day because, for linear surveys, the base-rover communication link tend to degrade with separation.

ACORN’s bases are located in maintenance sheds, so they do not require supervision, they are available 24/7, they are secure, and their position is of the highest accuracy. The communication link is via cell-phone modems, so their availability is not limited by line-of-sight

problems as with FM radios. Also, because it is a network of base stations, ACORN can create a “virtual” base station that follows the rover throughout the day. A virtual base station is created by sophisticated software that pools the observables from the network together to interpolate the observable that would have been recorded by an actual base station located very close to the rover. Virtual base stations completely eliminate the need to field an actual, physical base station receiver, and they move automatically and instantaneously along with their rover, which eliminates the need to move an actual base station and mitigates accuracy degradation from base-rover separation. The software and hardware system that implements such real-time positioning is called a Real-Time Network (RTN). For many surveying and mapping tasks, RTN positioning gives a dramatic efficiency improvement over RTK positioning.

## B. Project Synopsis

During the execution of the previous MOU between CTDOT and UCONN (MOU-S2319-1-2019-10), there were areas that were deemed to need further investigation. They were:

- Insufficient coverage along state borders, particularly in the northwest portion of the state
- Connectivity issues with GPS satellites for the devices the inspectors are using on certain projects
- The need to upgrade software operating the ACORN network and test the replacement software
- Continued verification of CTDOT surveying and construction operations to ensure that the system works throughout the state using active projects

## C. Objective

CTDOT requires real-time network positioning to support the activities of construction inspectors, engineers, and surveyors. The inspectors will use the RTN in conjunction with SCS900 software (Trimble) along with the 3D CADD models (Bentley) to perform post-construction assessment of deliverables from contractors. Survey Operations will use the RTN for positioning activities that do not require geodetic-quality accuracy. The 2022-2027 objectives are to maintain and operate ACORN in a production mode.

## D. Work Plan

The following work tasks will be accomplished:

- 1) Continue the partnership with neighboring states to stream data from their CORS network to enhance the ACORN network. These base stations include:
  - (A) URIL – Kingston, RI
  - (B) MASB - Sturbridge, MA
  - (C) MASH - Sheffield, MA
  - (D) NYRH - Riverhead, NY
- 2) Add RIPV (Providence, RI) if and when it becomes operational. Consider adding other future stations, as well, especially along the western border with New York.
- 3) Continue to perform validation and re-validation of system spatial integrity with the total station purchased under the previous MOU. Any time the system receives a major upgrade to PIVOT™ (the software that is used to operate the base stations and to perform real-time positioning), the operating environment, or the geodetic coordinates prompts re-occupying previously surveyed monuments to ensure ACORN's positioning capability has not been compromised. This total station uses the same software as the handheld devices that the inspectors have been using (SCS900).
- 4) Update and test new versions of PIVOT as they become available. Re-validate the system if the update is major enough to warrant it.
- 5) Author yearly recommendations and report.

## **Appendix I. Budget**

University of Connecticut Sponsored Program Services						6 mos	12 mos	12 mos	12 mos	12 mos	6 mos	
ACORN						Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total
						01/01/2022-06/30/2022	07/01/2022-06/30/2023	07/01/2023-06/30/2024	07/01/2024-06/30/2025	07/01/2025-06/30/2026	07/01/2026-12/31/2026	
A. Senior Personnel	Salary	Appt	Months Effort	% Effort								
Thomas Meyer, PI AY			-			-	-	-	-	-	-	-
			-			-	-	-	-	-	-	-
<b>B. Other Personnel</b>												
Post Docs			-									
Graduate Assistants - AY Level 3 year 1	\$16,118	5	5.00	100.00%		16,118						16,118
Graduate Assistants - AY Level 3 Year 2-5	\$29,592	9	9.00	100.00%			29,592	30,184	30,788	31,404		121,968
Graduate Assistants - AY Level 3 Year 6	\$14,236	4	4.00	100.00%							14,236	14,236
Graduate Assistants - Sum Level 3 year 1	\$3,273	1	1.00	100.00%		3,273						3,273
Graduate Assistants - Sum Level 3 year 2-5	\$10,015	3	3.00	100.00%			10,015	10,215	10,419	10,627		41,276
Graduate Assistants - Sum Level 3 year 6	\$7,227	2	2.00	100.00%							7,227	7,227
Network Operator, Kevin Franklin, SPAR year 1	\$7,398	6	6.00	100.00%		7,398						7,398
Network Operator, Kevin Franklin, SPAR year 2-5	\$15,536	12	12.00	100.00%			15,536	16,313	17,129	17,985		66,963
Network Operator, Kevin Franklin, SPAR year 6	\$9,442	6	6.00	100.00%							9,442	9,442
					<b>Total Salaries</b>	26,789	55,143	56,712	58,336	60,016	30,905	287,901
<a href="#">Enter Fringe Rates</a>												
<b>C. Fringe Benefits</b>												
Thomas Meyer, PI AY												
Graduate Assistants AY	15.8%	16.3%	16.8%	17.3%	17.3%	2,547	4,823	5,071	5,326	5,433	2,463	25,663
Graduate Assistants SUM	21.9%	22.5%	23.0%	23.5%	23.5%	717	2,253	2,349	2,448	2,497	1,698	11,962
Network Operator, Kevin Franklin, SPAR	21.9%	22.5%	23.0%	23.5%	23.5%	1,620	3,496	3,752	4,025	4,226	2,219	19,338
					<b>Total Fringe Benefits</b>	4,884	10,572	11,172	11,799	12,156	6,380	56,963
					<b>Total Salaries &amp; Fringes</b>	31,673	65,715	67,884	70,135	72,172	37,285	344,864
<b>D. Equipment</b>	*											
<b>E. Travel</b>	Domestic											
	Foreign											
<b>F. Participant Support Costs</b>	# of Participants: _____											
Stipends												
Travel												
Subsistence												
Other												
					<b>Total Participant Costs</b>	-	-	-	-	-	-	-
<b>G. Other Direct Costs</b>												
Materials & Supplies-Equipment - Maintenance & Replacement Costs						2,500	2,500	2,500	2,500	2,500	2,500	15,000
Publication Costs												-
Pivot system maintenance costs						63,654	31,807	31,807	31,807	31,807	15,904	206,786
Trimble Business Center Software						6,563	1,325	1,325	1,325	1,325	663	12,526
Subawards	**											-
Other - CTDOT SIM Cards						6,000	12,000	12,000	12,000	12,000	6,000	60,000
					<b>Total Other Direct Costs</b>	78,717	47,632	47,632	47,632	47,632	25,067	294,312
<b>H. Total Direct Costs</b>	YR 1	YR 2	YR 3	YR 4	YR 5& 6	110,390	113,347	115,516	117,767	119,804	62,352	639,176
<b>I. Indirect Costs (F&amp;A) @ 20% per waiver</b>	20.0%	20.0%	20.0%	20.0%	20.0%	22,078	22,669	23,103	23,553	23,961	12,470	127,834
<a href="#">Enter Indirect Cost Rates</a>												
<b>J. Total Costs</b>						\$132,468	\$136,016	\$138,619	\$141,320	\$143,765	\$ 74,822	\$ 767,010
<b>Indirect Cost Base (TDC)</b>						\$110,390	\$113,347	\$115,516	\$117,767	\$119,804	\$ 62,352	\$ 576,824

## TITLE VI CONTRACTOR ASSURANCES

During the performance of this contract, the contractor, for itself, its assignees and successors in interest (hereinafter referred to as the "contractor") agrees as follows:

1. **Compliance with Regulations:** The contractor (hereinafter includes consultants) will comply with the Regulations relative to Nondiscrimination in Federally-assisted programs of the United States Department of Transportation Federal Highway Administration and Federal Transit Administration, as they may be amended from time to time, which are herein incorporated by reference and made a part of this contract.

2. **Nondiscrimination:** The contractor, with regard to the work performed by it during the contract, will not discriminate on the grounds of race, color, national origin, sex, age, disability, income or Limited English Proficiency in the selection and retention of subcontractors, including procurements of materials and leases of equipment. The contractor will not participate directly or indirectly in the discrimination prohibited by the Acts and Regulations, including employment practices when the contract covers any activity, project, or program set forth in Appendix B of 49 CFR Part 21.

3. **Solicitations for Subcontracts, Including Procurements of Materials and Equipment:** In all solicitations, either by bidding, or negotiation made by the contractor for work to be performed under a subcontract, including procurements of materials, or leases of equipment, each potential subcontractor or supplier will be notified by the contractor of the contractor's obligations under this contract and Acts and the Regulations relative to Non-discrimination on the grounds of race, color, or national origin.

4. **Information and Reports:** The contractor will provide all information and reports required by the Acts, the Regulations, and directives issued pursuant thereto and will permit access to its books, records, accounts, other sources of information, and its facilities as may be determined by the Recipient or the Federal Highway Administration or Federal Transit Administration to be pertinent to ascertain compliance with such Acts, Regulations, and instructions. Where any information required of a contractor is in the exclusive possession of another who fails or refuses to furnish this information, the contractor will so certify to the Recipient or the Federal Highway Administration or the Federal Transit Administration, as appropriate, and will set forth what efforts it has made to obtain the information.

5. **Sanctions for Non-compliance:** In the event of the contractor's non-compliance with the Non-discrimination provisions of this contract, the Recipient will impose such contract sanctions as it or the Federal Highway Administration or the Federal Transit Administration may determine to be appropriate, including, but not limited to:

- a. withholding contract payments to the contractor under the contract until the contractor complies; and/or
- b. cancelling, terminating, or suspending a contract, in whole or in part.

## TITLE VI CONTRACTOR ASSURANCES - page 2

6. **Incorporation of Provisions:** The contractor will include the provisions of paragraphs one through six in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Acts, the Regulations and directives issued pursuant thereto. The contractor will take action with respect to any subcontract or procurement as the Recipient or the Federal Highway Administration or the Federal Transit Administration may direct as a means of enforcing such provisions including sanctions for noncompliance. Provided, that if the contractor becomes involved in, or is threatened with, litigation by a subcontractor, or supplier because of such direction, the contractor may request the Recipient to enter into any litigation to protect the interests of the Recipient. In addition, the contractor may request the United States to enter into the litigation to protect the interests of the United States.



## TITLE VI CONTRACTOR ASSURANCES - page 3

During the performance of this contract, the contractor, for itself, its assignees, and successors in interest (hereinafter referred to as the "contractor") agrees to comply with the following non-discrimination statutes and authorities; including but not limited to:

### **Pertinent Non-Discrimination Authorities:**

- Title VI of the Civil Rights Act of 1964 (42 U.S.C. § 2000d et seq., 78 stat. 252), (prohibits discrimination on the basis of race, color, national origin); and 49 CFR Part 21.
- The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, (42 U.S.C. § 4601 ), (prohibits unfair treatment of persons displaced or whose property has been acquired because of Federal or Federal-aid programs and projects);
- Federal-Aid Highway Act of 1973, (23 U.S.C. § 324 et seq.), (prohibits discrimination on the basis of sex);
- Section 504 of the Rehabilitation Act of 1973, (29 U.S.C. § 794 et seq.), as amended, (prohibits discrimination on the basis of disability); and 49 CFR Part 27;
- The Age Discrimination Act of 1975, as amended, (42 U.S.C. § 6101 et seq.), (prohibits discrimination on the basis of age);
- Airport and Airway Improvement Act of 1982, ( 49 USC § 4 71, Section 4 7123 ), as amended, (prohibits discrimination based on race, creed, color, national origin, or sex);
- The Civil Rights Restoration Act of 1987, (PL 100-209), (Broadened the scope, coverage and applicability of Title VI of the Civil Rights Act of 1964, The Age Discrimination Act of 1975 and Section 504 of the Rehabilitation Act of 1973, by expanding the definition of the terms "programs or activities" to include all of the programs or activities of the Federal-aid recipients, sub-recipients and contractors, whether such programs or activities are Federally funded or not);
- Titles II and III of the Americans with Disabilities Act, which prohibit discrimination on the basis of disability in the operation of public entities, public and private transportation systems, places of public accommodation, and certain testing entities (42 U.S.C. §§ 12131-12189) as implemented by Department of Transportation regulations at 49 C.F.R. parts 37 and 38;
- The Federal Aviation Administration's Non-discrimination statute (49 U.S.C. § 47123) (prohibits discrimination on the basis of race, color, national origin, and sex);
- Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, which ensures discrimination against minority populations by discouraging programs, policies, and activities with disproportionately high and adverse human health or environmental effects on minority and low-income populations;
- Executive Order 13166, Improving Access to Services for Persons with Limited English Proficiency, and resulting agency guidance, national origin discrimination includes discrimination because of limited English proficiency (LEP). To ensure compliance with Title VI, you must take reasonable steps to -ensure that LEP persons have meaningful access to your programs (70 Fed. Reg. at 74087 to 74100);
- Title IX of the Education Amendments of 1972, as amended, which prohibits you from discriminating because of sex in education programs or activities (20 U .S.C. 1681 et seq)