NYSEARCH RD&D
Division of the NORTHEAST GAS ASSOCIATION

Beyond GPS: Gas Pipeline RTK Mapper and Rethinking Urban Spatial Positioning

NYSEARCH

- 501(c)6 Non-Profit
- Part of the Northeast Gas Association (NGA)
- Manages RD&D projects selectively funded by our 20+ members who operate natural gas transmission and distribution assets across North America
- These projects aim to advance the safety, integrity and efficiency of the gas utility industry

Leak Detection	Low Carbon Fuels	Installation, Maintenance and Repair	Non-Destructive Examination	Reducing GHG Emissions	Pipe Location

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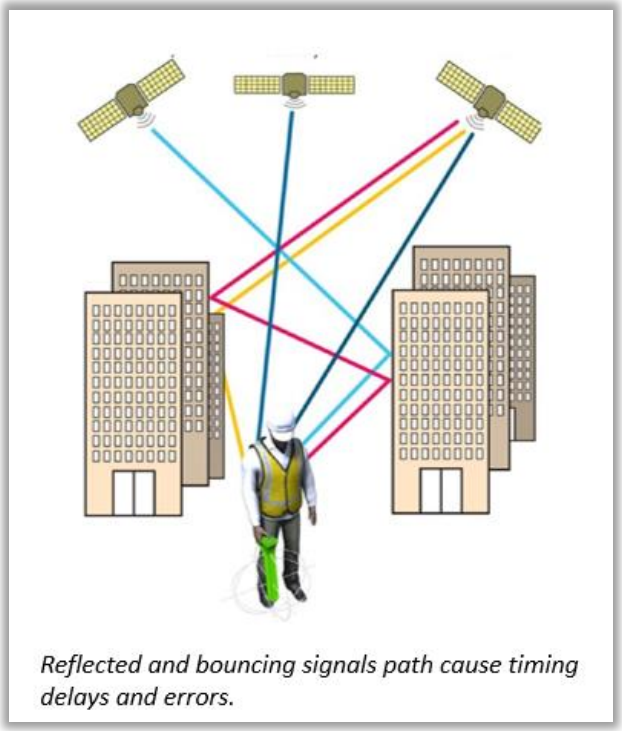
Urban Canyons

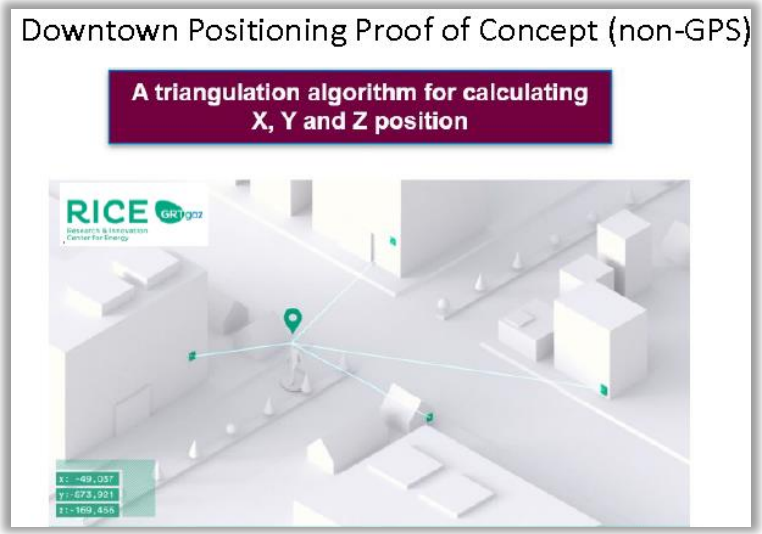
- The biggest challenge for mapping assets with RTK mappers is in downtown areas
- Large buildings obstruct the sky and block/delay satellite signals
- Urban canyon phenomenon causes multipath signals causing positioning errors
- Current technology using IMU, Cameras, LiDAR, etc., can be expensive and not suitable for utility mapping applications



Reflected and bouncing signals path cause timing delays and errors.

NYSEARCH Project M2024-001
e-Nails

- This ongoing project with NaTran and UTTO aims to use ultrawideband (UWB) technology to allow for asset mapping in urban canyons
- Four radio beacons are mounted to buildings within the area of interest and used as anchors to improve locating for operators utilizing compatible UWB devices (Rover)
- Coverage Area
  - 0.25 mi^2
- Target Locate Accuracy in urban canyons
  - Within 10cm
- Future plans include upgrading *vLocater,* an RTK mapper developed and commercialized by NYSEARCH and UTTO to work with *e-Nails*



Regulatory and Compliance Exploration Phase

Objective:

Whether the proposed technology is permissible or could be granted a waiver of any FCC CFR (Code of Fed Regulations) prohibitions - Section 15.250 for UWB

Results:

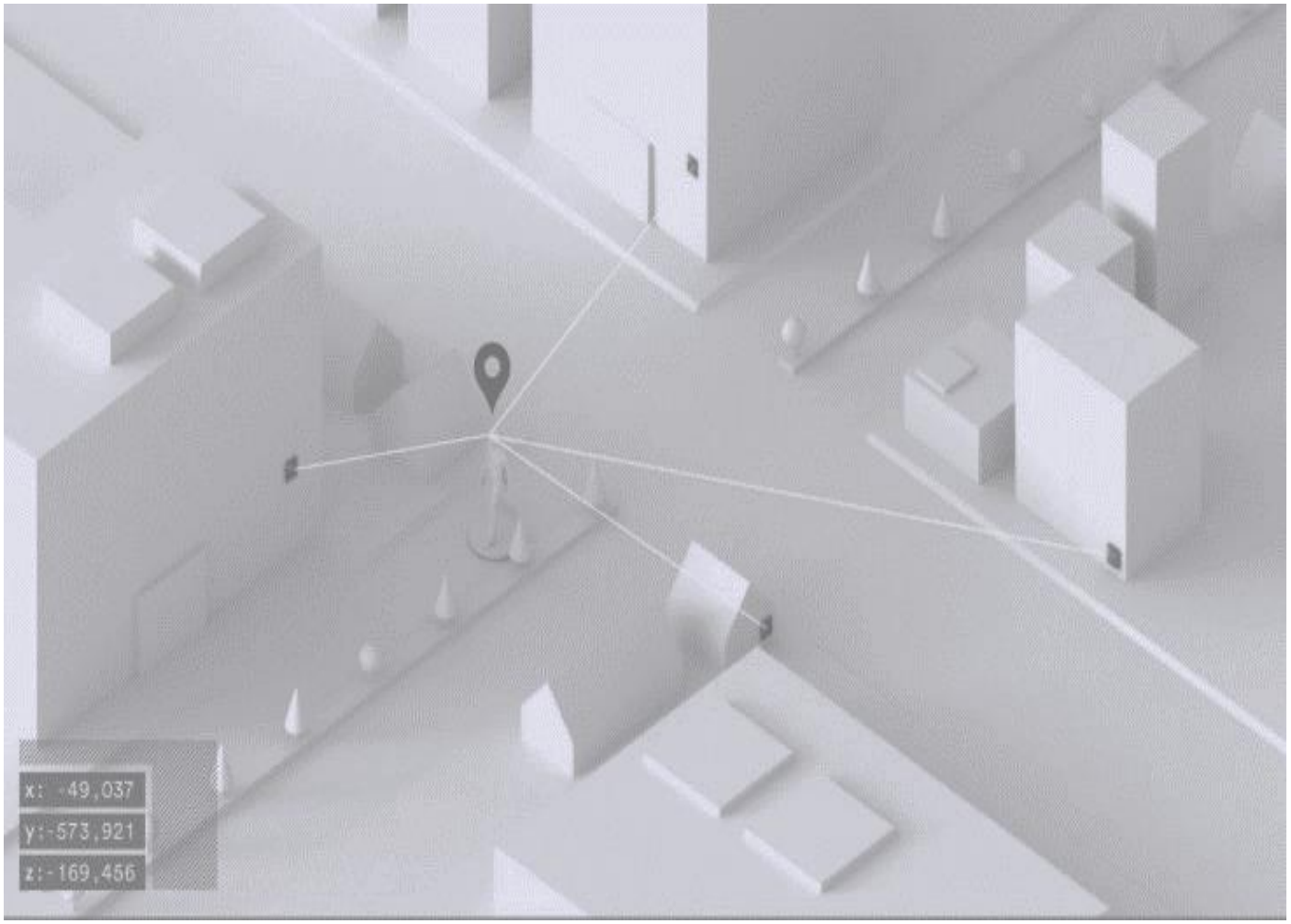
The FCC has not provided commentary on what does and does not qualify as a “fixed, outdoor infrastructure.”

The FCC’s rules seem overly broad, and it seems to prefer to retain control by granting waivers for new UWB products and technologies on a case-by-case basis.

The FCC grants waivers routinely, and we have found no denial of a petition for waiver, even after speaking with the FCC directly.

Conditions for the FCC granting a waiver seem very favorable

Alpha Test Site Identification

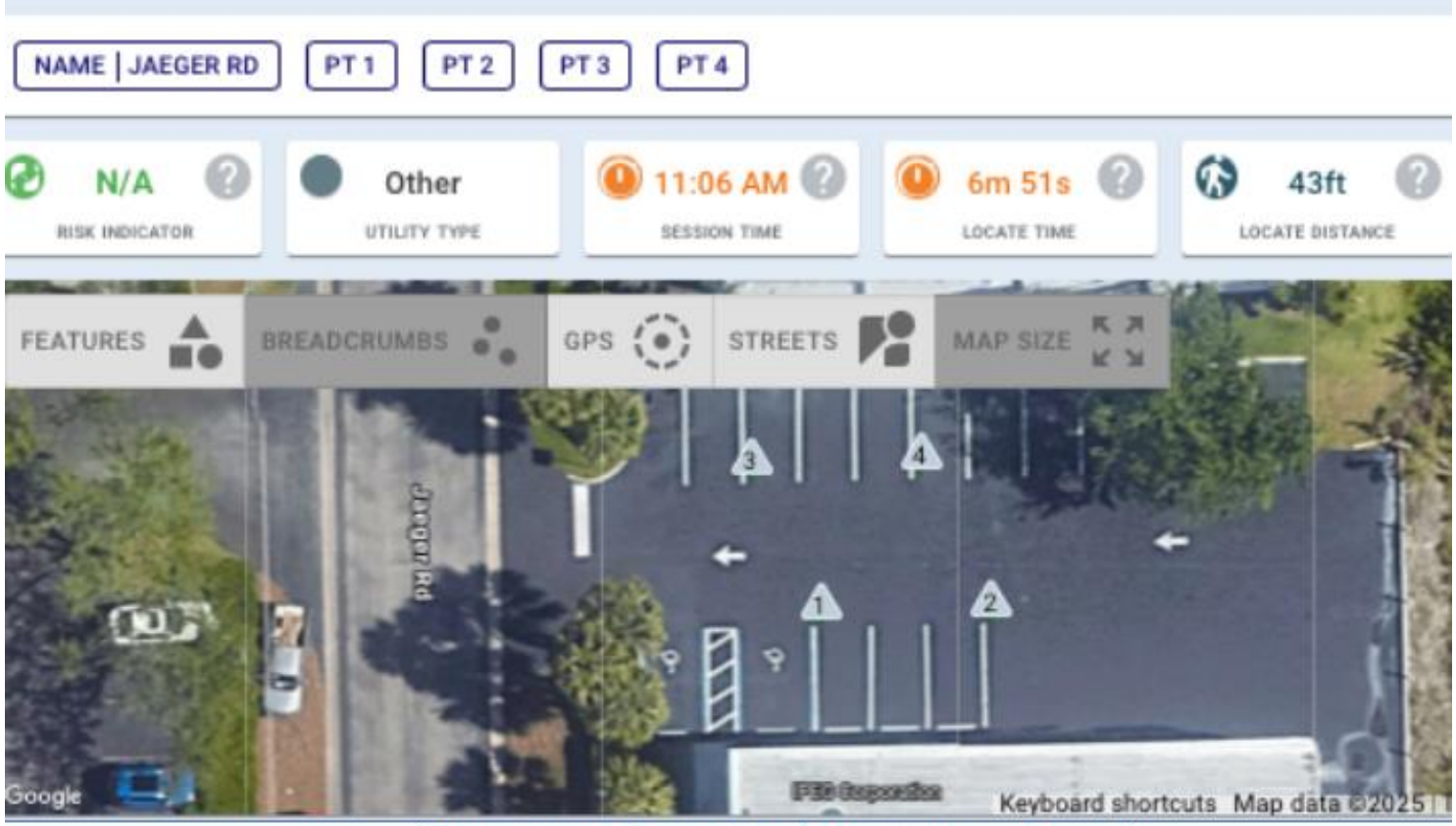


Initial Test Results (Part A)

Four tripods were used as monuments each placed as random locations including heights. The monuments were surveyed using UTTO's vLocate Mapper and the surveyed points were used as references.

Monument physical locations

Feb 2025: Summary of early results encouraging ☺



Surveyed Monuments from UTTO's Locate Assurance Site

Tags	Locate Point ID	Timestamp	Latitude	Longitude	Height MSL_MM	PDOP	SV Count	Positioning Mode
Pt 1	1424851	2025-04-09T15:06:32Z	26.2145143	-81.7848678	5711	0.96	32	R
Pt 2	1424850	2025-04-09T15:08:15Z	26.2145155	-81.7847856	5353	1.01	32	R
Pt 3	1424849	2025-04-09T15:10:17Z	26.2145763	-81.7849013	5602	0.91	32	R
Pt 4	1424848	2025-04-09T15:13:23Z	26.2145787	-81.7848197	5928	0.86	32	R

Monument Survey Results

5. Data Conversions and Calculations

Asset		Time Stamp (utc)	Lat	Lon	Height (mm)	Lat [rad]	Lon [rad]	Hor Dev	
1 (Reference)			26.2145143	-81.7848678	5711	0.457529586	-7.710600529	(meters)	(in)
Point 1	1st Session	5:36:11 PM	26.214517846	-81.784865639	8.97891577250415	0.457529648	-7.710600491	0.449420603	18
		5:37:09 PM	26.214518279	-81.784865202	8.82866186731754	0.457529656	-7.710600483	0.512716721	20
		5:38:13 PM	26.214517888	-81.784865376	9.01866926848069	0.457529649	-7.710600486	0.466541408	18
	2nd Session	8:59:11 PM	26.214519877	-81.784866773	9.55494877111858	0.457529684	-7.710600511	0.628529422	25
		8:59:53 PM	26.214518709	-81.784866087	9.36090779354548	0.457529663	-7.710600499	0.519176185	20
		9:00:27 PM	26.214517631	-81.784865784	9.44313535156149	0.457529644	-7.710600493	0.421451016	17
2 (Reference)			26.2145155	-81.7847856	5353	0.457529607	-7.710599094		
Point 2	1st Session	5:38:48 PM	26.214518986	-81.784785062	8.15816405271041	0.457529668	-7.710599085	0.391283992	15
		5:39:49 PM	26.214519329	-81.784784747	8.47924184638765	0.457529674	-7.710599079	0.434213453	17
		5:40:53 PM	26.214519960	-81.784784699	8.57700260966658	0.457529685	-7.710599078	0.503963517	20
	2nd Session	9:00:54 PM	26.214519725	-81.784784884	8.48234341219029	0.457529681	-7.710599081	0.475224026	19
		9:01:28 PM	26.214519311	-81.784784946	8.38883032731858	0.457529674	-7.710599083	0.428731908	17
		9:02:02 PM	26.214519260	-81.784785252	8.07754432575298	0.457529673	-7.710599088	0.41948735	17
3 (Reference)			26.2145763	-81.7849013	5602	0.457530668	-7.710601113		
Point 3	1st Session	5:41:40 PM	26.214575079	-81.784898610	5.89807398452841	0.457530647	-7.710601066	0.300711766	12
		5:42:42 PM	26.214575878	-81.784898776	6.43173205549721	0.457530661	-7.710601069	0.256089935	10
		5:43:46 PM	26.214577035	-81.784899133	8.45452801021168	0.457530681	-7.710601075	0.2310703	9
	2nd Session	9:02:46 PM	26.214577831	-81.784897349	8.11518615933881	0.457530695	-7.710601044	0.429370728	17
		9:03:21 PM	26.214578599	-81.784897893	7.95222353859698	0.457530709	-7.710601054	0.425354999	17
		9:03:43 PM	26.214577279	-81.784897720	7.84548488680617	0.457530686	-7.710601051	0.373307039	15
4 (Reference)			26.2145787	-81.7848197	5928	0.45753071	-7.710599689		
Point 4	1st Session	5:44:17 PM	26.214580165	-81.784817888	7.91587264074570	0.457530736	-7.710599657	0.243370515	10
		5:45:22 PM	26.214579688	-81.784818230	7.76435473175893	0.457530728	-7.710599663	0.183215566	7
		5:46:25 PM	26.214579774	-81.784818013	7.67797707943138	0.457530729	-7.71059966	0.206342679	8
	2nd Session	9:04:16 PM	26.214579640	-81.784818829	7.11283089924347	0.457530727	-7.710599674	0.135953409	5
		9:04:47 PM	26.214578009	-81.784819619	3.99127518964421	0.457530698	-7.710599688	0.077256289	3
		9:05:22 PM	26.214587541	-81.784817791	15.73030966544120	0.457530865	-7.710599656	1.001350719	39

6. Methodology

To calculate the distance between two latitude longitude points, the Haversine formula and the spherical law of cosines were used:

Haversine formula:

R = earth's radius (mean radius = 6,371km)

difflat = lat2 - lat1

difflong = long2 - long1

$a = \sin^2(difflat/2) + \cos(lat1) \times \cos(lat2) \times \sin^2(diflong/2)$

$c = 2 \times atan2(sqrt(a), sqrt(1-a))$

$d = R \times c$

Spherical law of cosines:

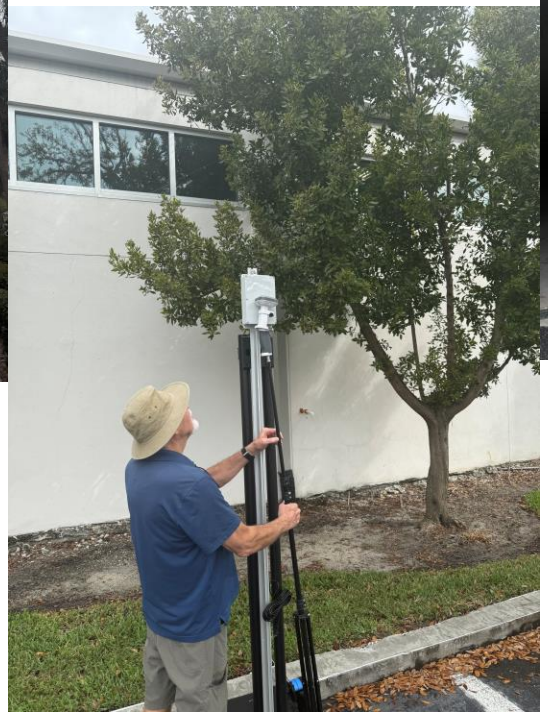
$d = acos(sin(lat1).sin(lat2)+cos(lat1).cos(lat2).cos(long2-long1)).R$

And as implemented in Excel:

- E2: =SIN(ABS(B3-B2)*PI()/180/2)^2+COS(B2*PI()/180)*COS(B3*PI()/180)*SIN(ABS(C3-C2)*PI()/180/2)^2

Alpha Site (Part B)

March 2025: Installation of eNail Anchors



5. Protocole

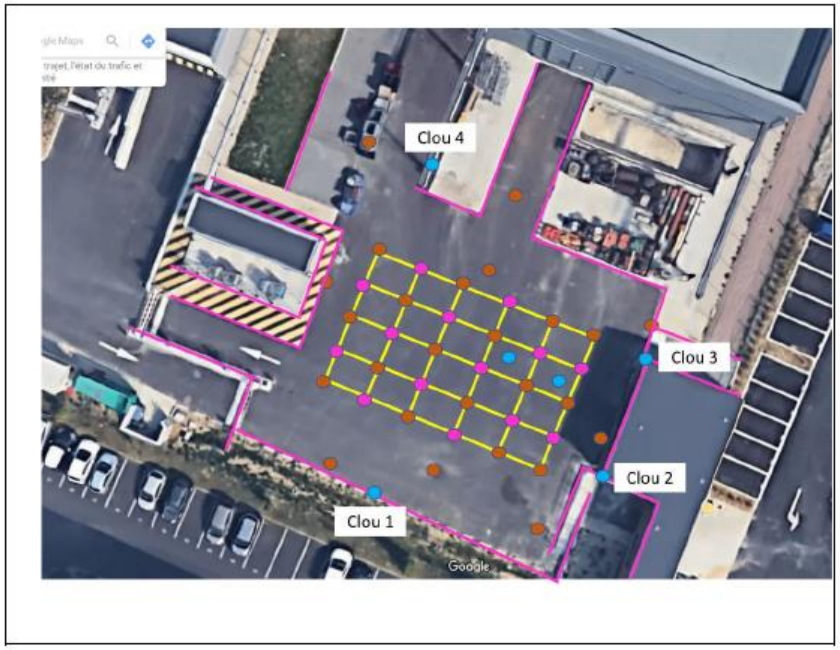
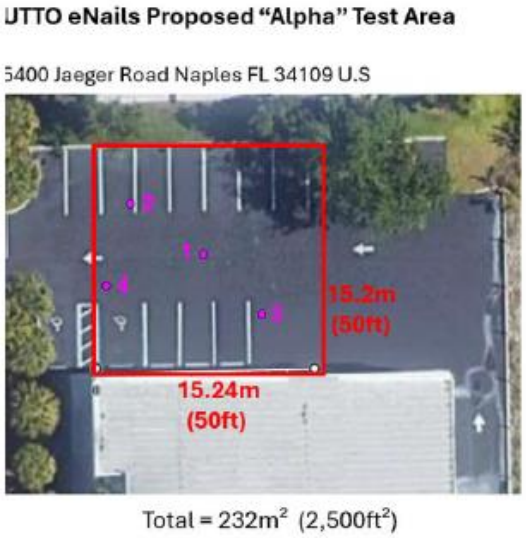


Figure 1 : Map of nails and georeferenced points in Villeneuve la garenne

In Florida we recommend doing a few point survey (1, 2, 3, 4 points of comparison

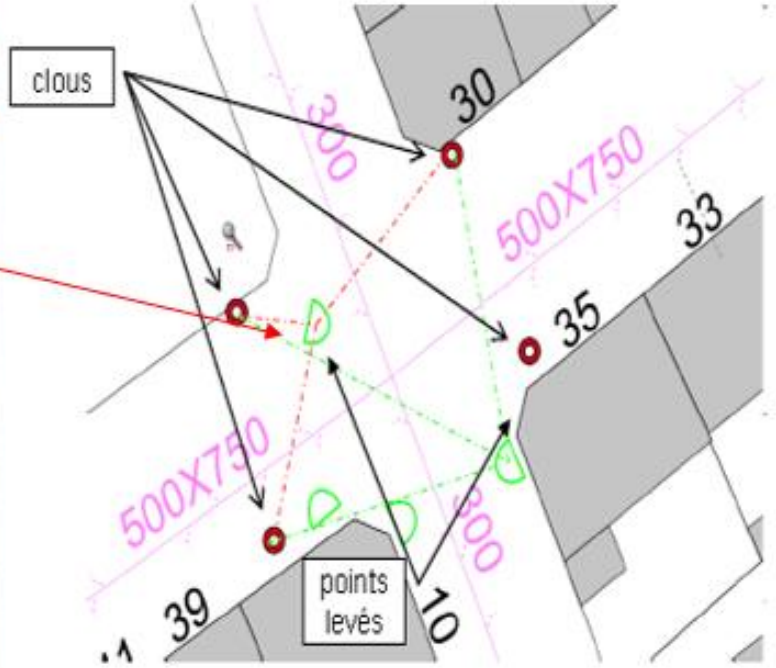


Total = 232m² (2,500ft²)

A number of points are surveyed for testing.

For each measurement point, the calculated position is recorded using the web software's "Capture" function "https://uwb.exelen.ch/logs".

What’s Next – Mobile App + vLocate Mapper Integration & Beta Site Testing



vLocate Mapper® - Integration of UWB technology and leverage existing cloud platform and APIs.

Questions

Contact Info

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