

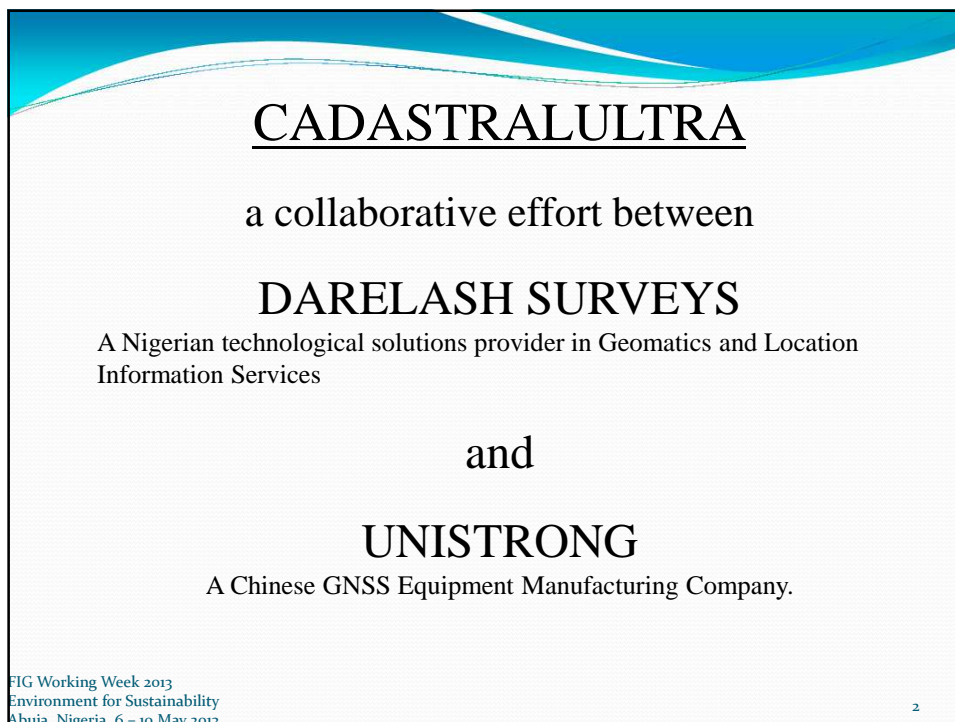
**CadastralUltra: A Purpose-Built Low Cost GPS System for Cadastral Surveying in Nigeria**

By

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FIG Working Week 2013  
Environment for Sustainability  
Abuja, Nigeria, 6 – 10 May 2013

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**CADASTRALULTRA**

a collaborative effort between

**DARELASH SURVEYS**  
A Nigerian technological solutions provider in Geomatics and Location  
Information Services

and

**UNISTRONG**  
A Chinese GNSS Equipment Manufacturing Company.

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# CADASTRALULTRA

consists of

2 x Handheld GPS receivers (single frequency-L1)	2 x External GPS Antennas (single frequency-L1)	1 x Static GPS Data Post Processing Software	1 x External GPS Antenna Pole	1 x Handheld GPS receiver Clamp
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based on

Price, Accuracy, Easy-to-Use and Durability (PAED)



### CADASTRALULTRA HANDHELD GPS RECEIVER SPECIFICATIONS

<b>Specification System</b>	<b>Data Communication</b>	<b>Environment</b>
<ul style="list-style-type: none"> <li>• Microsoft Windows Mobile 6.5</li> <li>• CPU: 600MHz</li> </ul> <b>GPS</b> <ul style="list-style-type: none"> <li>• Channel: 14, L1 C/A code</li> <li>• Hot-start: 1s</li> <li>• Cold-start: 29s</li> <li>• Real-time: &lt; 3.5 m (CEP, -130 dBm)</li> </ul> <b>Screen</b> <ul style="list-style-type: none"> <li>• Screen: 3.5' QVGA TFT, sunlight - readable color touch screen</li> <li>• Keyboard: night visible</li> </ul>	<ul style="list-style-type: none"> <li>• Storage: 128MB SDRAM±256M NAND flash</li> <li>• SD slot: Micro SD 32G</li> <li>• Port: Mini USB2.0</li> <li>• Bluetooth: Bluetooth V2.0,EDR</li> </ul> <b>Power</b> <ul style="list-style-type: none"> <li>• Battery: 2800mAh Li-ion battery</li> <li>• Working time: 10h(typical)</li> <li>• External power: 3.3V~5V</li> <li>• Power consumption: 0.5W</li> </ul>	<ul style="list-style-type: none"> <li>• Working temperature: -10°C -- +60°C</li> <li>• Storage temperature: -30°C -- +70°C</li> <li>• Shock: 1.5m drops to concrete</li> <li>• Waterproof/dustproof: IEC 529-IP66</li> </ul> <b>Extension</b> <ul style="list-style-type: none"> <li>• Camera: 5 megapixel</li> <li>• Gravity sensor</li> <li>• Cellular modem</li> </ul> <b>Physical</b> <ul style="list-style-type: none"> <li>• Dimension: 179.5mm*91.2mm*31.5mm</li> <li>• Weight: 250g(Without battery)</li> </ul>

### **CadastralUltra is based on Static GPS baseline post processing.**

By this, one unit is setup on a known station called master or reference station and the other unit called the rover is used to acquire GPS data for a period of time at the desired property beacons simultaneously as the master station unit.

The coordinates of the property beacons are obtained from post processed master-rover baselines and network adjustment.

Duration of data acquisition of the rover at the property beacon depends on the base line but usually based on empirical formula as;

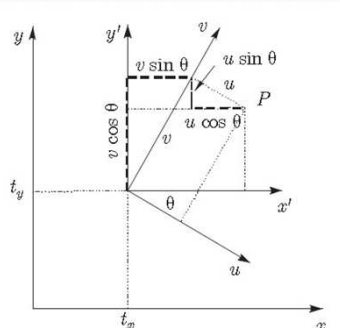
*For single frequency receiver: Baseline observation time = 10 minutes + 1 minute/km*

### EXPECTED ACCURACIES

Survey type	Baseline length (km)	# satellites	GDOP	Observation time	Accuracy
Static	20-50	$\geq 4$	$\leq 6$	2 - 3 hr	5 mm + 1 ppm
	50-100	$\geq 4$	$\leq 6$	min. 3 hr	5 mm + 1 ppm
	> 100	$\geq 4$	$\leq 6$	min. 4 hr	5 mm + 1 ppm

### COORDINATES TRANSFORMATION

The transformation of the obtained UTM coordinates to Nigerian coordinates system is carried out by applying previously determined best fitting 2D conformal transformation parameters of; translations ( $t_E$  and  $t_N$ ), rotation ( $\theta$ ) and scale ( $s$ ), for the area of survey.





### **Cadastral Surveying: What is it and why do we need it?**

Cadastral surveying is that branch of surveying which is concerned with the survey and demarcation of land for the purpose of defining the dimensions, location and orientation of land parcels in some coordinates system. While cadastre of a country is its register of titles, cadastral plan as obtained from cadastral survey is the foundation block of the cadastre.

It is the only aspect of surveying that has legal status as the practice is regulated by the laws of the land the world over.

In Nigeria, it constitute 70% of all survey activities is the largest “employer” of surveyors in the country and is therefore the jewel in the crown of the survey profession in the country.

### **Historical Evidence of Practice of Cadastral Surveying**

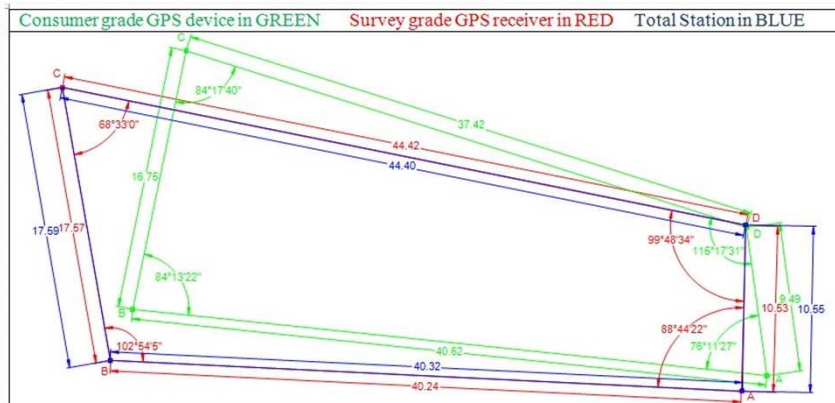
Over 3500 years old Babylonia records of boundary demarcation.

Romans giving distinctive title of AGRIMENSORES to cadastral surveyors.

Evidence of cadastral survey in Egypt to recover lost boundary after the perennial Nile River flooding.

**Observed Current Practice in Nigeria**

As a result of high cost of survey grade GPS systems, cadastral surveyors do use recreational grade systems which do not yield required accuracies as shown below:



SURVEY METHOD	DIMENSIONS OF THE LAND PARCEL(m)				PERIMETER (m)	AREA (m <sup>2</sup> )	Diff(m)	% Diff	Diff(m <sup>2</sup> )	% Diff
	AB	BC	CD	DA			PERIMETER (TAPE FIXED)		AREA (TOTAL STATION FIXED)	
Survey Grade GPS	40.24	17.57	44.42	10.53	112.76	574.991	-0.15	0.13	1.441	0.25
Consumer Grade GPS	40.62	16.75	37.42	9.49	104.28	498.930	8.33	7.40	77.502	13.45
Total Station	40.37	17.62	44.46	10.56	112.86	576.432	-0.25	0.22	0.000	0.00
Measuring Tape	40.22	17.56	44.30	10.53	112.61	NA	0.00	0.00	NA	NA

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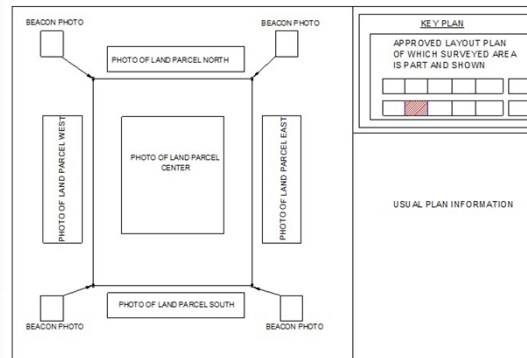
Effects of Continual use of Recreational Grade GPS system	
<p>This will create problems in future when there will be need for property beacon re-establishment as the positional accuracy of these systems is at best 2m.</p>	
<p>There will also be problems during setting out of structures when more accurate systems would be used as land may not be were they surveyors says it is.</p>	
<p>In litigation, it will be ridiculous if two surveyors present significantly different coordinates of the same property beacon.</p>	

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### Further Suggestions for Improvements in Cadastral Surveying Practice in Nigeria

In this information age, the current cadastral plan format is no longer adequate, below is a proposed format; also, the size should also be increased from A4 to A3.

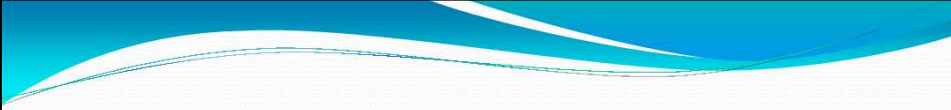


The Surveyor-Generals Forum in conjunction with NIS and SURCON should set out guidelines for the use of GPS in cadastral surveying.

Since survey is on the concurrent list, the Nigerian GNSS Reference Network (NIGNET) can be augmented by having each state Surveyor General Office set up a GNSS Continuous Operating Reference Stations (CORS) and this can be extended to the Local Government Headquarters. A dedicated website should be established where surveyors can download GPS data in RINEX format. In such a situation, the surveyor only need one unit of the like of CadastralUltra as the nearest NIGNET station will suffice as a master station. This will make cadastral surveys all over the country uniform.

Surveyors should not carry out survey of a plot that is not part of an approved layout plan therefore, concerned authorities should make such approved layout plans accessible to the surveyors.






**Conclusions**

Cadastral survey practice in Nigeria can be made to be professionally, intellectually and financially rewarding as any other aspect of the profession and in general any other profession.

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**THANK YOU**

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