FAQ: Using Local Coordinate Systems in MobileMapper Office

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Thesis:

On occasion a MobileMapper user may be confronted with a 'Local Coordinate System'. This FAQ shows how to compute a local coordinate system for use with MMO.

Since this is a fairly complex issue, a complete worked example is presented. It is assumed that the reader knows how to convert from geographic coordinates to state plane coordinate.

Example:

(The files used in this example are included in a ZIP file ASHDN.ZIP)



Find two points on opposite corners of a job. I prefer to use the south west most point and the north west most point. In this example:

Desc	Ptip	Lat	Lon	SPX	SPY	LocalX	LocalY
LowerLeft	18	37 42 41.29161	113 02 19.92664	1195280.30	10226593.80	121799.88	119533.38
UpperRight 🖊	12	37 42 49.97054	113 02 08.22120	1196235.20	10227456.10	122739.81	120411.85

SPX, SPY, LocalX and LocalY are given in US Survey Feet.

1. We need to compute the effective combined scale factor that the local coordinate system is using to convert from grid to ground coordinates. This scale factor is the distance from point 18 to point 12 grid coordinates divided by the distance from point 18 to point 12 local coordinates:

K = 1286.62 / 1286.91 = 0.999773875

2. MobileMapper needs coordinate values in meters so we need the state plane and local coordinates computed in Meters for the base point "18":

37 42 41.29161 -113 2 19.92664 NAD83(geographic)1195280.3 SFt E 10226593.8 SFt N UTS NAD83(UTS NAD83 Survey Ft)364322.2 M E 3117072.0 M N UTS NAD83(UTS NAD83 Meters)

In addition we need the local coordinates for this point in meters. Be sure to use the correct constant for survey feet to meters (YES: 0.30480060960122; WRONG 0.3048)!:

121799.88 sft East 119533.38sft North(local survey feet)37124.38 meters East 36434.00 meters North(local meters)

3. Compute the rotation from state plane grid to local coordinate grid. (Don't forget to compute result in Degrees NOT Radians):

Vector from 18 to 12 in state plane: ArcTan(dy, dx) = 42.082873 degrees Vector from 18 to 12 in local coordinates: ArcTan(dy, dx) = 43.017515

Local coordinates are rotated 0.93464233 west of state plane. i.e. "the basis of bearings for local coordinates is 0.93 degrees west of state plane north."

Convert rotation in decimal degrees to dms:

0.93464233 degrees is 0 degrees 56 minutes 4.71 seconds.

4. Now we need to define a local coordinate system in Mobile Mapper Office. Open MobileMapper with no job. Select "Options: Select Coordinate System...":

Select Coordinate System	×
Spatial Reference System	
LG WGS 84	•
OK Cancel	

Press the drop arrow to the right of "WGS 84" and select "<New>":

Coordinate	System Wizard - Welcome	×
Welcon	ne to Coordinate System Wizard	
This wi	zard will help you :	
ß	SELECT a PRE-DEFINED system	
N [™] ≷ ↓_E	C Define a NEW PROJECTED system (EASTING, NORTHING, HEIGHT)	
L ×	C Define a NEW GEOGRAPHIC system (LATITUDE, LONGITUDE, HEIGHT)	
	< Back Next > Cancel Help	

With "Select a Pre-Defined system" selected Press "Next". Select "USA" and then pick the state plane coordinate system that makes sense for the job you are working with. In this case we computed offsets from Utah South NAD83 so you need to pick "NAD83" in the left box and "USA/NAD83/Utah (South)" in the right-hand box:

Coordinate System Wizard - Sel	ect	×
Coordinate System Wizard - Sel	Name Image: Instant Structure Image: Instant Structure	Datum NAD83
	< <u>B</u> ack Finish	Cancel Help

Press "Finish":

Select Coordinate System	$\mathbf{\overline{\mathbf{N}}}$
Spatial Reference System	
La USA/NAD83/Utah (South)	•
OK Cancel	

Now press the "..." button to the right of "USA/NAD83/Utah (South):

Projected System [USA/NAD83/Utah (South)]	×
Datum Projection System	
System Name : USA/NAD83/Utah (South)	
East V	
North	
Height O Up With vertical correction H => H local	
Unit Name : Meters	
Meters per unit : 1	
Vertical Datum : 🔘 Ellipsoid 🗨	
Vertical Unit Name : Meters	
Meters per unit : 1	
Set Vertical Unit = Horizontal Unit	
OK Cancel Apply Help	

Change the "System Name" to something that makes sense for your job. In this case I use "AshdnFP6", choose the Units that you want for displayed coordinates "Survey Feet":

Projected System [AshdnFP6]	×
Datum Projection System	
System Name : AshdnFP6	
East - East	
North	
Height O Up With vertical correction H => H local	
Unit Name : Survey Feet	
Meters per unit : 0.30480060960122	
Vertical Datum : 🚫 Geoid03 📃 💌	
Vertical Unit Name : Survey Feet	
Meters per unit : 0.30480060960122	
Set Vertical Unit = Horizontal Unit	
OK Cancel Apply Help	Ī

Now select the Projection tab, check the 'With horizontal correction $(E,N) \Rightarrow (E,N)$ local' and enter all of the numbers that we computed above:

Projected System [AshdnFP6]	
Datum Projection System	
Projection Class : A Lambert_Conformal_Conic_2	With horizontal correction (E,N) => (E,N) local
latitude_of_origin 36° 40' 00.00000''N	Easting of origin (E0) : 37124.380 m
central_meridian 111° 30' 00.00000''W	Northing of origin (N0) : 36434.000 m
standard_parallel_1 38° 21' 00.00000''N	Scale factor (K): 0.999773875000
standard_parallel_2 37° 13' 00.00000''N	Easting offset (DE) : -364322.200 m
false_easting 500000.000 m	Northing offset (DN): -3117072.000 m
false_northing 3000000.000 m	Rotation angle (Beta) : 0° 56' 04.71000"
	$ \begin{array}{l} E \mbox{ local = E0 + 1/K [(E + DE) \cos(Beta) \cdot (N + DN) \sin(Beta)]} \\ N \mbox{ local = N0 + 1/K [(E + DE) \sin(Beta) + (N + DN) \cos(Beta)]} \end{array} $
	OK Cancel Apply Help

Note that the Easting Offset and Northing Offsets need to be negative (if the state plane coordinates are positive).

Press OK:

Select Coordinate System	\mathbf{X}
Spatial Reference System	
∜\$ AshdnFP6	•
OK Cancel	

Finally press OK to return to the map display screen:



Now we can test our new local coordinate system by importing a DXF that uses the defined coordinate system. Select "File: Import" and browse for the DXF file (in this case it is named MarkDXFOut.dxf):

Import GIS I	Jata		? 🔀
Look in: 🗀	LocalCoordinates	- 🗢 🗈 🖻	* III •
MarkDXFO	ut.dxf		
File name:	Made DXFOut def		Open
nio <u>n</u> amo.			
Files of type:	AutoCAD Files (*.dxf)	_	Cancel

Press 'Open', MMO will show you the layers it found in the dxf:

Import GIS Data 🛛 🔀
Coordinate System: AshdnFP6
C \Documents and Settings\Mark\My Documents\MagellanProfessio EASEMENT PRO-TBC LOTS PL CL ADJ PRO-TBC-Line LOTS-Area EASEMENT-Line DIM PRO-TBC-Point DIM-Point
<
Import Cancel

Finally press 'Import':



Now let's verify that the local coordinates for our control points are correct. Zoom to the south west corner and place the pointer tool over the control corner:



The displayed coordinates should match the local coordinates of the point.



Now move the drawing so that you are centered near the other control point and repeat:

Again, we expect the coordinate to match the local coordinates for the point (at least to our ability to hold the cursor near the center of the point).

Now that we have verified that the MobileMapper Office local coordinate system matches the drawing (dxf) file, we can build a base map for the MobileMapper Pro:

Get an empty job (so we don't have two copies of the base layer) by pressing "File: New". Decline to save the current job.

Next select the main menu option "Tools: Background Maps":

M Background Maps	×
Vector Maps 🎇 Raster Maps	
	Map Editor
	Attach Map
	Detach Map
	Remove
OK Cano	el Help

Select the "Vector Maps" tab, then press "Map Editor...":

🗏 Vector Map Editor - Untitled 🛛 🛛 🔀						
<u>File L</u> ay	<u>File Layer Operations</u>					
🗅 🖻	D 🖻 🖬 🎒 🏄 🎜 🎜 🖆 🔛					
Map Nar	Map Name NewMap Map Scale 1: 100,000 💌					
Map Layers						
Legend	Name	Scale	Display Attribute	Source File		
L						

Select "Layer: Add...":

Add Layers	? 🛛
Look in: 🗀 burtonnichols	- ← 🗈 📸 -
ishpa.shp shpl.shp shpp.shp	
File <u>n</u> ame:	<u>O</u> pen
Files of type: Shape Files (*.shp)	▼ Cancel
Coordinates in: AshdnFP6	

Note that our new coordinate system 'AshdnFP6' is listed as 'Coordinates in:'. Change the "Files of type" drop down to (*.dxf), then highlight the DXF you wish to import:

Add Layers				? 🔀
Look <u>i</u> n: 🗀	burtonnichols	•	ڭ 🖻	•
AshsdownF	^v hase6.dxf ut.dxf			
File <u>n</u> ame:	Mark DXFOut.dxf			<u>O</u> pen
Files of type:	AutoCAD Files (*.dxf)		•	Cancel
Coordinates in:	AshdnFP6			

Press 'Open':

🕌 Vector Map Editor - Untitled * 🛛 🔀						
<u>File L</u> ay	<u>File Layer Operations</u>					
D 🖻	D 🚔 🖶 🎒 🌲 🌲 🗣 📓					
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мармаг	ne AshDwn	мар 5са	ie 1: 100,000	•		
Map Layers						
Legend	Name	Scale	Display Attribute	Source File		
•	DIM-Point	100,000	- Not Selected -	C:_TMP\burtonnichols\MarkDXFOut.dxf		
•	PRO-TBC-Point	100,000	- Not Selected -	C:_TMP\burtonnichols\MarkDXFOut.dxf		
\sim	DIM	100,000	- Not Selected -	C:_TMP\burtonnichols\MarkDXFOut.dxf		
\searrow	EASEMENT-Line	100,000	- Not Selected -	C:_TMP\burtonnichols\MarkDXFOut.dxf		
\searrow	PRO-TBC-Line	100,000	- Not Selected -	C:_TMP\burtonnichols\MarkDXFOut.dxf		
\searrow	ADJ	100,000	- Not Selected -	C:_TMP\burtonnichols\MarkDXFOut.dxf		
\searrow	CL	100,000	- Not Selected -	C:_TMP\burtonnichols\MarkDXFOut.dxf		
\sim	PL	100,000	- Not Selected -	C:_TMP\burtonnichols\MarkDXFOut.dxf		
\searrow	LOTS	100,000	- Not Selected -	C:_TMP\burtonnichols\MarkDXFOut.dxf		
	LOTS-Area	100,000	- Not Selected -	C:_TMP\burtonnichols\MarkDXFOut.dxf		
	PRO-TBC	100,000	- Not Selected -	C:_TMP\burtonnichols\MarkDXFOut.dxf		
	EASEMENT	100,000	- Not Selected -	C:_TMP\burtonnichols\MarkDXFOut.dxf		

Futz around with the colors and fills and get them how you want them, then select "Operations: Create Map". Wait a bit (about 10 seconds on my machine), then select "File: Save As" and enter a suitable name ("AshDwn" in this case).

Finally select "File: Exit" to return to the "Background Maps" dialog:

Maps Background Maps	X
Vector Maps Raster Maps	1
9 AshDwn	Map Editor
	Attach Map
	Detach Map
	Remove
ОК Са	ncel Help

Press "OK":

You should have a background map that shows the contents of the DXF file:



You can transfer this map into the receiver using the main menu option "File: Upload to GPS: Background Map". (You MUST have the receiver connected to the serial port at this point.) Follow the onscreen instructions.