Coordinate Inaccuracies

X•DOT, Inc.

Presented

by

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Introduction

- Review FCC/FAA coordinate and elevation requirements
- FAA Accuracy Codes
- Examples – Tower site, Buildings
- Short path coordinate accuracies effect on azimuth

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Two FCC Parts Have Exactly the Same Accuracy Requirements

- FCC Part 101.21(e)
- FCC Part 101.103(d)(2)(ii)

"The position location of antenna sites shall be determined to an accuracy of no less than ±1 second in the horizontal dimensions (latitude and longitude) and ±1 meter in the vertical dimension (ground elevation) with respect to the National Spacial Reference System."

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FCC Part 1.923(c) Antenna Locations

Applications for stations at fixed locations must describe each transmitting antenna site by its geographical coordinates and also by its street address, or by reference to a nearby landmark. Geographical coordinates, referenced to NAD83, must be specified in degrees, minutes, and seconds to the **nearest second of latitude and longitude**.

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FAA Accuracy Requirements Coordinates

FAA Form 7460-1 Notice of Proposed Construction or Alteration instructions state: ”latitude and longitude must be geographic coordinates, accurate to within the nearest second or the nearest hundredth of a second if known….”

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FAA Accuracy Requirements
Elevation

- The elevation accuracy is not specifically stated except that it should match the contour elevations shown on an accompanying map of Item #20 of the FAA Form 7460-1.

- The FAA does ask that the elevation be rounded to the next highest foot.

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FAA Accuracy Codes

Horizontal		Vertical	
Code	Tolerance	Code	Tolerance
1	20’	A	3’
2	50’	B	10’
3	100’	C	20’
4	250’	D	50’
5	500’	E	125’
6	1000’	F	250’
7	½ NM	G	500’
8	1 NM	H	1000’
9	Unknown	I	Unknown

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Same Site

Coordinates are all different but they are for the same site and are FCC legal

Elevations are also FCC legal

Site1

33 17 37.37
110 50 10.74
7798.7’ AMSL

50.4 Feet 70.126 Degrees

37.98 Feet

Site 2

33 17 37.2
110 50 11.3
7799.8’ AMSL

57.96 Feet
110.411 Degrees

Site 3

33 17 37.00
110 50 10.66
7799’ AMSL

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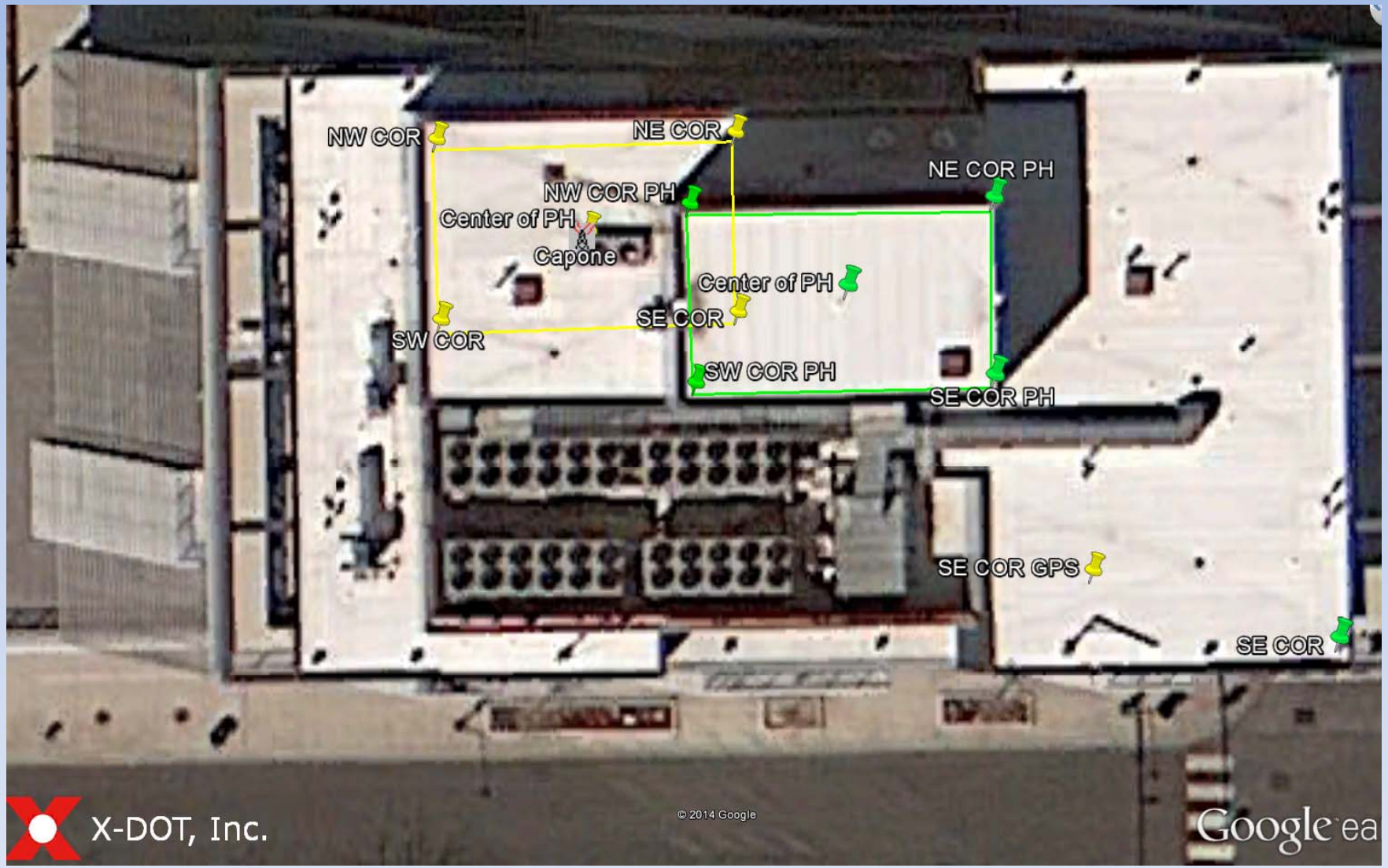
Example of error when selecting coordinates from Google Earth Images
Yellow = GPS coordinates, Green= actual roof locations where point data was gathered



Picture is offset/skewed by approximately 37 feet
Elevation given by Google is the ground not the top of the building

Red dots=GPS coordinate values. Picture is offset/skewed by approximately 9 feet
Elevation from Google is ground not the height of the building

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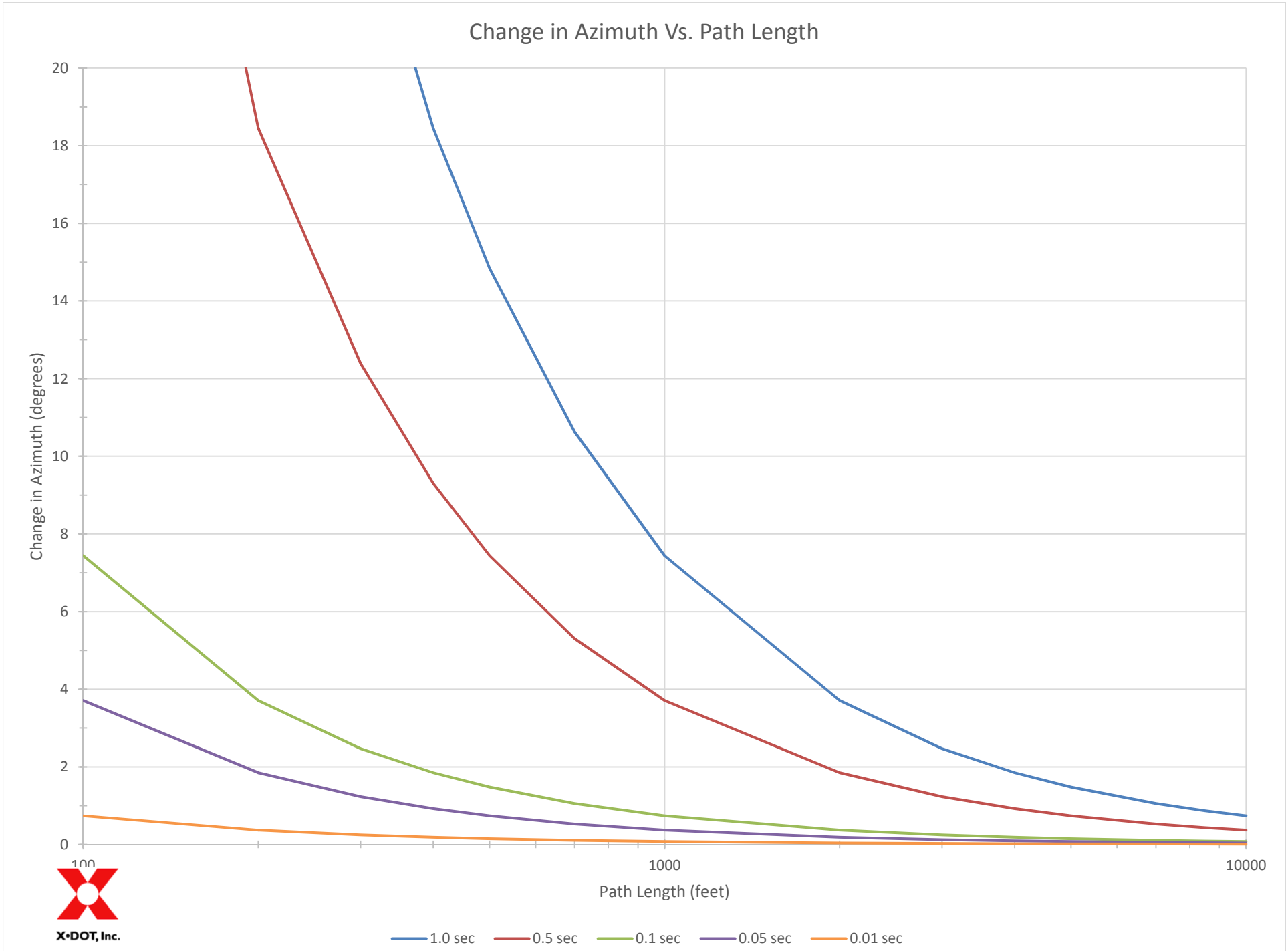
Change in Azimuth Vs. Path Length
Change in Azimuth (degrees)
20
18
16
14
12
10
8
6
4
2
0
100
1000
10000
Path Length (feet)
1.0 sec
0.5 sec
0.1 sec
0.05 sec
0.01 sec
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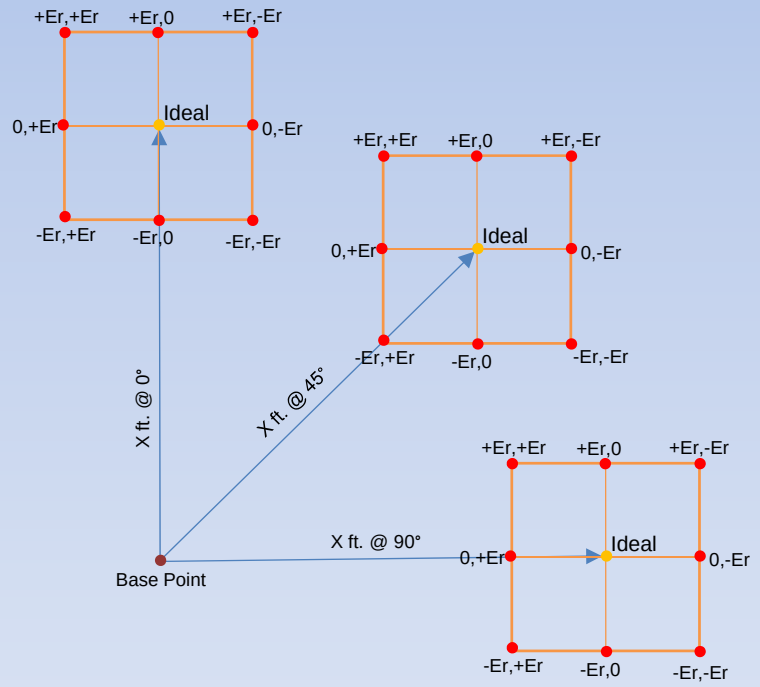
+Er,+Er
+Er,0
+Er,-Er
0,+Er
Ideal
0,-Er
-Er,+Er
-Er,0
-Er,-Er
X ft. @ 0°
X ft. @ 45°
X ft. @ 90°
Base Point

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Graph Explanation

- Please refer to the Figure 1 and the Graph on the following pages. Assume the Base Point is one end of three microwave paths and it does not change. The other ends of the three paths are called Ideal points. The coordinates of the Ideal ends are changed by varying amounts to simulate the coordinate changes as explained below. We want to determine the difference in azimuth for the Ideal ends of the microwave paths.
- **One:** As most know the length of a second of longitude varies for different locations within the United States and the length of a second of latitude is constant. Any latitude or longitude may be used for this study. All microwave transmit locations in the FCC's ULS database were averaged and the resultant latitude and longitude was used for the Base Point.
- **Two:** Starting with a path length of 100 feet, NGS Forward is used to determine three sets of latitude and longitude with path azimuths at 0, 45 and 90 degrees. These are the Ideal ends of the three paths.
- **Three:** At each of three Ideal ends of the three 100 foot long paths the coordinates were assumed to be changed .01 second. You could think of that change as an error in the coordinate. The latitude and longitude of each of the three Ideal ends were shifted by ±.01 second in .01 second increments to generate eight separate points. Refer to Figure 1.
- **Four:** For each of the eight separate points in the third step, calculate the new path azimuths from the Base Point using NGS Inverse and find the difference in azimuth from the path to the Ideal end.
- **Five:** From each of the differences in azimuths calculated in step four find the maximum.
- **Six:** The second through the sixth steps are repeated for the following path lengths: 200, 300, 400, 500, 700, 1000, 2000, 3000, 4000, 5000, 6000, 7000, 8500, and 10,000 feet.
- **Seven:** The entire process is repeated for assumed changes (errors) of .05, .1, .5 and 1.0 second.