New GNSS Developments & Their Impact on Surveyors

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A "Messy" Future…

- **Given the varying time frames for introduction of new services, the coming years will be "messy" for users.**
- **Surveyors wants as many signals as possible, as soon as possible and make measurements that are as accurate as possible using equipment that is as inexpensive as possible.**
- **So, I want to concentrate on one issue…**
- ***What capabilities will be available when?***

GPS Surveying Receivers…cm accuracy RT or PP

Decreasing cost

L1	L2 codeles	L2C	L5	# sats 2010 *# sats 2015*	Comments
28 ***36***	**10** ***0***	**18** ***36***	**10** ***28***	28/10-DF, 10-TF *36-DF, 28-TF*	**A Can old Rx track L2C in codeless mode?**
28 ***36***	**-** **-**	**18** ***36***	**10** ***28***	18/10-DF, 10-TF *36-DF, 28-TF*	**B**
18 ***36***	**-** **-**	**18** ***36***	**-** **-**	18-DF *36-DF*	**C**

A: Rx tracks all sats, *highest* availability, *highest cost*, *improvement* in DF-only performance over current system, *no* TF-only positioning until 2015, *best hybrid*.

B: *Moderate cost* Rx, DF-only performance *improved* in 2015, *no* TF-only positioning until 2015, *good hybrid positioning*.

C: *Lowest cost* Rx, DF-only performance (*decreased* performance in 2010, but *improved* in 2015), *no TF positioning possible*.

GALILEO[1]/GPS[2] Surveying Receivers…

Decreasing cost

L1[1,2]	E6[1]	L2C[2]	E5[1]/L5[2]	# sats 2010; *# sats 2015*	Comments
30/28 ***30/36***	**30** ***30***	**18** ***36***	**30/10** ***30/28***	60-DF[1],28-DF[2]; 30-TF[1],10-TF[2] *60-DF[1],64-DF[2]; 30-TF[1],28-TF[2]*	**A** **GPS+GALILEO**
30/28 ***30/36***	**-** ***-***	**18** ***36***	**30/10** ***30/28***	30-DF[1],28-DF[2]; 10-TF[2] *30-DF[1],64-DF[2]; 30-TF[1]*	**B** **GPS+GALILEO**
30 ***30***	**30** ***30***	**-** ***-***	**30** ***30***	60-DF[1]; 30-TF[1] *60-DF[1]; 30-TF[1]*	**C** **GALILEO**
30 ***30***	**-** ***-***	**-** ***-***	**30** ***30***	30-DF[1] *30-DF[1]*	**D** **GALILEO**

A: Top-of-line GNSS Rx tracks all sats, *highest* availability, *highest cost*, *highest* in DF-only & TF-only performance, *best hybrid*.

B: *Moderate cost* GNSS Rx tracks all sats, but does not track E6, GPS TF-only positioning available 2015, *good price/performance compromise*.

C: *Moderate cost* GALILEO-only surveying Rx, TF-only positioning available 2010, *unclear if tracking of E6 requires user charges for CS*.

D: *Lowest cost* GALILEO-only surveying Rx, DF-only performance (*similar* to current GPS-only performance in 2010), *uses OS signals only*.

Additional Comments…

- **The previous table gets even more complicated if one adds GLONASS (QZSS etc) into the scenarios.**
- **These complications apply not only to users but also to infrastructure suppliers such as IGS, RTK Network providers etc.**
- **Thinking for Surveying is also based on assumption that we will continue to need carrier phase measurements for centimetre accuracy… but new signals may deliver several centimetre accuracy using ranging alone (?)**
- **If so, there is a whole other set of possible scenarios for some applications.**
- **ICG should be a discussion forum to help FIG IAG etc to (in turn) help users understand these issues as they unfold.**